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FEDERAL EMERGENCY MANAGEMENT AGENCY

UNITED STATES FIRE ADMINISTRATION

NATIONAL FIRE ACADEMY

FOREWORD

The Federal Emergency Management Agency (FEMA) was established in 1979. FEMA's mission is to focus federal effort on preparedness for, mitigation of, response to, and recovery from emergencies encompassing the full range of natural and manmade disasters.

FEMA's National Emergency Training Center in Emmitsburg, Maryland, includes the United States Fire Administration (USFA), its National Fire Academy (NFA), and the Emergency Management Institute (EMI).

To achieve the Academy's legislated mandate (under Public Law 93-498, October 29, 1974) "to advance the professional development of fire service personnel and of other persons engaged in fire prevention and control activities," the National Fire Academy has developed an effective program linkage with established fire training systems which exist at the state and local levels. It is the responsibility of this division to support and strengthen these delivery systems. Academy field courses have been sponsored by the respective state fire training systems in every state.

This curriculum is designed to meet the needs of fire officers and crew leaders with responsibilities to manage the operations of one or more companies in structural firefighting operations. The course components of this curriculum include preparation for response, decisionmaking, and tactical operations. The foundation of the course is an extensive use of simulation to provide application of concepts and the development of skill.

Managing Company Tactical Operations: Preparation is designed to provide a basic foundation for the management of one or more companies operating at a structural fire emergency. The focus of these five modules is a review of basic concepts and development of proficiency in critical skills. Key content includes Roles and Responsibilities, Readiness, Communication, Building Construction and Fire Behavior Factors, and Preincident Preparation.

Recently, the curriculum for this course has been revised. The revisions were made to apply recent work in naturalistic decisionmaking, and particularly a Recognition-Primed Decision (RPD) model of how fireground commanders actually make decisions when faced with time pressure and uncertainty.

Calderwood (*Fire Command,* August, 1988) has described the research project that showed that fireground commanders rarely generate alternative options and evaluate these options systematically to select the best. There simply is not sufficient time. Moreover, the fireground commanders are able to use their experience

to identify a reasonable course of action as the first one they consider. Generally, commanders take advantage of their experience to initiate a course of action rapidly, which is how they can make decisions so quickly. If the commanders are concerned about whether the typical course of action will be successful in the actual situation they are facing, the common strategy is to imagine how the course of action will be carried out, looking for ways in which it might lead to complications. If none are found, the course of action is initiated. If minor complications are found, the fireground commander will try to improve the action. If the improvements aren't going to work, the commander will reject the action and consider another typical strategy.

Although the RPD model appears to describe how fireground commanders make decisions, we have not included the model in the student materials. Little is to be gained by explaining to you how you already think. Instead, the revisions have been based on the RPD model. Since situation awareness, or sizeup, is so central to effective decisionmaking, we have enhanced the materials describing the critical cues for making difficult judgments. Critical cues are those that can cause a shift or an elaboration in the commander's assessment of the situation. This should help you gain a better sense of what you are monitoring. A second modification is to provide guidance to instructors about how best to use debriefings that follow exercises.

As you proceed through the course, you may have questions that can't be answered in these materials. The United States Fire Administration (USFA) has many publications that may be helpful. A list of these can be obtained by calling 1-800-238-3358, extension 1358.

To request one of these publications by title or by publication number, call the automated service number: 1-800-238-3358, extension 1660.

The USFA's Learning Resource Center also is available to assist with further research; call 1-800-238-3358, extension 1030.

The staff of the National Fire Academy is proud to join with state and local fire agencies in providing educational opportunities to the members of the nation's fire services.

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MODULE 2: READINESS

OBJECTIVES

The students will:

1. *Prioritize personal values and describe their relationship to incident management and firefighter safety.*

2. *Describe the five elements of company readiness and explain the importance of each element.*

3. *Develop a personal plan for improving company readiness.*

NOTE-TAKING GUIDE

READINESS--AN INTRODUCTION

Definition: The fire company is ready when its members have the necessary knowledge, skills, and resources to carry out the tactical operations required to meet the goals and objectives of the IC.

Elements of company readiness.

COMPANY OFFICER'S PERSONAL READINESS

The CO must develop a body of knowledge that will provide for effective, safe company operations.

NOTE-TAKING GUIDE

The CO must recognize that his/her major role is to direct the efforts of others.

The **personal** characteristics that affect the ability to direct and perform are based upon:

General background knowledge.

COMPANY READINESS

Before the alarm.

During alarm.

Response to nonfire incidents. Are you prepared?

NOTE-TAKING GUIDE

Returning to service.

KNOWLEDGE OF DEPARTMENTAL OPERATIONS

Fire department organizational structure requires an understanding of:

Standard operating procedures (SOP's).

Command and control procedures.

KNOWLEDGE OF DISTRICT AND COMMUNITY

Two levels.

NOTE-TAKING GUIDE

Community risk assessment.

General knowledge of fire district.

KNOWLEDGE OF AVAILABLE RESOURCES

Resource inventory.

Balancing incident needs with resources.

Part of the readiness process for the CO is to plan for the organization and management of resources.

Effect of environment on resources.

NOTE-TAKING GUIDE

SUMMARY

There are five broad elements of company readiness:

The Personal Plan provides a tool for the student to apply the concepts presented in the module to his/her own situation, and it is most useful if it is reviewed and modified periodically.

INTRODUCTION

Fire departments exist to save lives and property. Professional COs respond to each incident knowing that they are ready to manage their part in meeting this goal efficiently and effectively. They must prepare themselves and their company, develop a thorough knowledge of departmental operations and procedures, a knowledge of their district and community, and a knowledge of the resources available to them.

PERSONAL READINESS

The CO must recognize that his/her major role is to direct the efforts of others. To do this, a body of knowledge that provides for effective, safe company operations must be developed. The personal characteristics that affect this ability to direct and perform are based on the CO's training and experience, knowledge of all aspects of operations, leadership and management ability, desire and motivation, and physical condition.

Values

Personal values are another component of the critical risk/benefit decision. The CO must be aware of the relationship between a person's personal values, and the impact that those values have on critical decisions that must be made quickly at incident scenes. The primary responsibility of the CO is his/her own safety and the safety of the firefighters of his/her company. The risks taken by personnel should be consistent with the potential results to be achieved.

Knowledge

Every CO should have background knowledge appropriate to the requirements of his/her own situation. Areas of general background knowledge include safety considerations, as applied to strategic, tactical and operational modes, building construction, and the ability to make fire behavior predictions. Communications skills, knowledge of strategy and tactics, the ability to analyze the company's performance at incidents, and an understanding of liability issues and the importance of accurate records and reports are also important.

A personal plan for improving those areas of identified weaknesses should be developed. Seeking continual improvement has long-term career development benefits.

COMPANY READINESS

The fire company is a team and may be called upon to work independently or with other companies as part of a response assignment. If the achievement of the IC's goal is dependent upon the readiness of the company, it follows that the CO has a big job preparing for it.

Before the Alarm

Readiness of both personnel and resources is critical to overall success. The CO must know the attitude toward safety, the motivational level, the physical condition, and the knowledge and skill level of company members. The collective capabilities of the group are important to allow adequate lead time when making incident assignments. It is the performance level of the group as a whole, rather than that of individuals, that should be measured in a non-threatening way. Apparatus, personal protective equipment, and firefighting equipment should be maintained properly and be available in adequate types and amounts.

During the Alarm

The company must be prepared to work as a tactical unit toward achieving the objectives assigned by the IC. The possibilities include functioning as a single unit at minor incidents, and functioning with other companies, where the CO serves as the IC until relieved or where the CO commands several companies.

Response to Nonfire Incidents

The company also must be prepared to deal with nonfire emergencies. Many departments provide EMS service, and almost all departments could become involved in various types of rescue situations. The public relations benefit of supplying nonemergency service, within policy constraints of the department, should not be overlooked and the company should prepare to provide those services.

Returning to Service

Returning the company to service is probably the least liked of company activities but is extremely important to the well-being of personnel at subsequent alarms. Personnel should be accounted for and rested. Apparatus and equipment should be serviced and repaired. The CO

should prepare the necessary reports and conduct a postincident information analysis--compliment personnel and note areas that require improvement.

KNOWLEDGE OF DEPARTMENTAL OPERATIONS

The CO must understand the organizational structure, relationship between line and staff personnel, and chain of command. Standard operating procedures provide guidelines for operations and should be simple and flexible, but should not remove the CO's decisionmaking responsibility. The CO should be thoroughly familiar with the department's command and control procedures and be ready to assume the various CO roles within the departmental ICS.

KNOWLEDGE OF DISTRICT AND COMMUNITY

Many fire officers have a general feeling for the nature of their fire problem, but have not thought in detail about how they would deal with all of the specific incident types facing them. Assessing the potential types of incidents that you will have to face in your community can help you begin to attack a fire even before you reach it (through preincident planning and training). The *Managing Company Tactical Operations: Simulation* materials provide an excellent resource for building these critical assessment skills. An understanding of the specific fire problems facing the CO is critical to company readiness. Determining the specific hazards that exist in the CO's district enables him/her to establish preincident planning and company training priorities.

Community Risk Assessment

Community risk assessment involves three elements: life risk, property risk, and consideration of community consequences. The risk/benefit decision that we have discussed must be made primarily through the consideration of these three elements. Life risk is affected by the number of people at risk, the degree of risk, and the ability of the occupants to provide for their own safety. Property risk is affected by construction factors, the condition of structures, exposures, occupancy, and the available water supply. Community consequences are determined by the potential impact of a specific incident on a specific community. Considerations include direct life loss and property damage potential, indirect losses such as wages and taxes, loss of pride and community spirit (e.g., a landmark destroyed), and environmental impact.

General Knowledge

General knowledge of your fire district is essential for quality company performance. This knowledge includes:

Characteristics of district: Size, population, valuation, response distances, and topography.

Access within district: The roads and streets and their conditions (normal day and night), unusual or restricted conditions affecting response.

Occupancy of the district: Businesses, industrial, schools, rest homes, theaters, airports, petroleum producers, residential, hotels.

Structural conditions in district: Old or new, widely spaced or congested, fire-resistive.

Contents and processes in district: Predominant industries, specialized processes.

Water supply in district: Sources, adequacy and reliability, storage, distribution, and auxiliary supplies such as private wells, lakes, streams, swimming pools.

Fire incidence in district: History of types, special problems encountered.

KNOWLEDGE OF AVAILABLE RESOURCES

Because the CO may function as the IC for some period at an incident, he/she must know about the availability of specific resources.

Resource Inventory

The CO should have available a resource inventory that provides a listing of special apparatus, information about personnel staffing and capability, and other local governmental and outside agencies that are available to assist with department operations. If a departmental resource inventory is not available, the CO can prepare an informal list of resources available in his/her own district.

Balancing Needs with Resources

Part of being ready is planning for the organization and management of resources. Anticipating needs in time so that adequate resources are available is a tough decision that is made even more difficult if sufficient planning has not been done prior to incident operations. Stay ahead of the fire. As identified in NFPA Standard 1500, a rapid intervention team (RIT) should be on scene to allow for timely reaction to unforeseen occurrences.

Effect of Environment on Resources

The CO should be aware of the effect of weather conditions on personnel, apparatus, and equipment. Rehabilitation areas should be established because fatigue tends to undermine safety. The CO should plan for backup resources so they are available when needed. In extreme environmental conditions, the CO should consider risks and benefits.

PERSONAL PLAN

The CO should develop a personal plan to assure that all aspects of company readiness have been considered. This plan will provide a focus for improvement. The plan will be most useful to the CO and to the department if the officer reviews and modifies it periodically.

SUMMARY

The ability of a fire company to perform is dependent upon the personal readiness of the CO, the personnel, apparatus, tools, and equipment assigned, and the knowledge that the company and the CO have of departmental operations, the district and community, and resources available. The company can only meet the challenges presented at the incident scene by always being "ready."

ACTIVITY 2.1

VALUES AND PRIORITIES

Purpose:

The purpose of this activity is to promote an awareness of the relationship between a person's values and the impact of those values on his/her actions.

Directions:

Rank the statements according to your own values, from most important (1) to least important (8) using the following ranking technique. Select the most important statement and write 1 in front of it. Select the least important statement and write 8 in front of it. Select most important of remaining statements and write 2 in front of it. Select least important of remaining statements and write 7 in front of it. Continue with this procedure until all remaining statements are rated.

My Rating	Group Rating	
_____	_____	Factors that indirectly endanger the lives of citizens.
_____	_____	Factors that directly endanger property.
_____	_____	Factors that will make fire department operations untenable.
_____	_____	Factors that directly endanger the lives of citizens.
_____	_____	Factors that will make the incident more complex if not remedied immediately.
_____	_____	Factors that indirectly endanger property.
_____	_____	Factors that directly endanger your own life.
_____	_____	Factors that endanger the lives of firefighters.

In your small group discuss your ratings and reach a group consensus.

ACTIVITY 2.2

PERSONAL PLAN, PART 1

SELF-IMPROVEMENT

Instructions:

You are beginning a planning process that will improve your company's operational readiness by focusing on areas that might require improvement. A byproduct of a company readiness improvement program will be your own professional growth.

At the end of each section of this module you will be asked to complete a part of a Personal Plan for improving your company's operational readiness. The time allotted will probably not be enough to complete it, but it is hoped that you will finish in a quieter and more reflective time. It is important to realize that this is a **personal** plan and the benefit that you and your department derive from it is a function of the thought and effort that you put into the planning process.

Based upon the information presented in this section of the module, what areas do you feel might require self-improvement, and how might you undertake those improvements?

Areas for Improvement	Things to do
General areas:	Examples:
Building construction	Attend NFA course
Fire behavior factors	Study in department
Communications skills	
Safety considerations	
Strategy, tactics, methods	
Incident analysis	
Liability issues	

ACTIVITY 2.2 (cont'd)

PERSONAL PLAN, PART 2

COMPANY IMPROVEMENT

Instructions:

Based upon the information presented in this section of the module, what areas do you feel might require improvement in your own operating unit, and how might you undertake those improvements?

Areas for Improvement	Things to do
General areas: Readiness before incident Personnel Apparatus Equipment Functioning as a tactical unit Readiness for nonfire incidents Returning to service	Examples:

ACTIVITY 2.2 (cont'd)

PERSONAL PLAN, PART 3

KNOWLEDGE OF DEPARTMENTAL OPERATIONS

Instructions:

Based upon the information presented in this section of the module, what areas do you feel might require improvement in your knowledge of departmental operations, and how might you undertake those improvements?

Areas for Improvement	Things to do
General areas: Fire department organizational structure SOP's Command and control procedures	Examples:

ACTIVITY 2.3

DEFINING THE FIRE PROBLEM

Purpose:

The purpose of this activity is to determine the types of fire hazards that exist in your district or community; to develop preincident planning priorities for CO; and to develop company training priorities.

Directions:

Students should take about 5 minutes to indicate by placing an F to the left of the three incident types to which their department most frequently responds, and an S to the left of the three most serious incident types facing their company or department.

TYPES OF EMERGENCY INCIDENTS IN YOUR COMMUNITY

I. Structure.
- A. Public assembly.
- B. Church.
- C. School.
  1. Classroom building.
  2. Housing.
  3. Plant operations.
  4. Data processing.
- D. Hospital/Nursing home.
- E. Residential.
  1. One- and two-family dwelling.
  2. Multiple occupancy.
  3. Apartment.
  4. Hotel/Motel.
  5. Motor home.
- F. Mercantile.
- G. Shopping center.
- H. Office building.
- I. Manufacturing.
- J. Research laboratory.
- K. Storage.

II. Vehicle.
- A. Automobile.
- B. Bus.
- C. Truck/Semi-trailer.
- D. Construction equipment.

III. Field/Woods/Forest.

IV. Refuse.

V. Rescue.
- A. Search--lost person.
- B. Vehicle extrication.
- C. Elevator rescue.
- D. Industrial accident.
- E. Water.

VI. Transportation incident.
- A. Highway.
- B. Railroad.
- C. Aircraft.
- D. Water.

VII. Hazardous condition--no fire.
- A. Electrical.
- B. Hazardous materials emergency.

VIII. Salvage.

IX. Smoke/Odor investigation.

X. Special hazards unique to community.

ACTIVITY 2.2 (cont'd)

PERSONAL PLAN, PART 4:

KNOWLEDGE OF DISTRICT AND COMMUNITY

Instructions:

Based upon the information presented in this section of the module, what areas do you feel might require improvement in your knowledge of your district and community, and how might you undertake those improvements?

Areas for Improvement	Things to do
General areas: Analysis of local fire problem Community risk assessment Knowledge of district Characteristics Access Occupancy Structural condition Contents and processes Water supply	Examples:

ACTIVITY 2.2 (cont'd)

PERSONAL PLAN, PART 5:

KNOWLEDGE OF AVAILABLE RESOURCES

Instructions:

Based upon the information presented in this section of the module, what areas do you feel might require improvement in your knowledge of available resources, and how might you undertake those improvements?

Areas for Improvement	Things to do
General areas: Resource inventory Balancing resources and needs Organizing and managing resources Effect of environment on resources	Examples:

MODULE 3: COMMUNICATION

OBJECTIVES

The students will:

1. *List four benefits of effective incident communications and explain the importance of each.*
2. *List the six steps identified in the communications model and explain the importance of each step.*
3. *Apply the communications model to practical incident communications when given a scenario.*

NOTE-TAKING GUIDE

UNDERSTANDING INCIDENT COMMUNICATIONS

Communication at the incident is more than just the officer yelling orders.

For communication to be effective, several important steps need to take place.

Communication is defined as:

Effective incident communication demands that a third step be included in the definition.

THE NEED FOR EFFECTIVE INCIDENT COMMUNICATIONS

Improved firefighter safety.

NOTE-TAKING GUIDE

Effective use of resources.

Improved interagency cooperation through good communication.

Legal implications.

THE NEED FOR A COMMUNICATIONS MODEL

Communications is a major factor in how well emergencies are managed.

Departments need to train on improving incident communications.

NOTE-TAKING GUIDE

Departments should have written communication procedures.

Written procedures provide a model to follow during training and at the incident.

THE COMMUNICATIONS MODEL

The model is a six-step process.

Sender formulates idea.

Sender sends message after getting attention of receiver.

Transfer the message through the medium.

Verbal.

Written.

Visual.

Nonverbal.

NOTE-TAKING GUIDE

Receiver receives message.

Receiver interprets message.

Receiver confirms message to sender.

Example of Communications Model in action:

Formulation of idea:

Sender: "I want Engine 1 to take 1-3/4" line to second floor." **(Thought)**

Sender: "Engine 1, Command." **(Getting attention of receiver)**

Transfer through medium: **(Radio transfers message from sender to receiver)**

Receiver: "Command, Engine 1." **(I'm paying attention)**

Sender: "Take 1-3/4" line to second floor." **(Conveying information)**

Receiver: "I'm going to have my crew take 1-3/4" line to second floor." **(Thought)**

NOTE-TAKING GUIDE

Receiver: "Taking 1-3/4" line to second floor." **(Feedback that Engine 1 understands assignment)**

Sender: "Affirmative, Engine 1."

BENEFITS OF USING THE COMMUNICATIONS MODEL

Confirmation that messages are received and understood.

Radio traffic is reduced because the communications model confirms receipt and understanding the first time.

TACTICAL COMMUNICATIONS RESPONSIBILITIES

When communication breaks down on the incident so do:

All personnel have the responsibility to communicate effectively.

NOTE-TAKING GUIDE

Types of tactical communications.

Tactical benchmarks.

All Clear.

Under Control.

Loss Stopped.

Progress reports from COs. "**Report on conditions**."

Reports of safety hazards or evacuation orders. "**Emergency traffic**."

Recommended written procedures to notify personnel to evacuate.

Blasts on the air horns.

Sirens.

NOTE-TAKING GUIDE

PA systems.

Anything loud and easily understood by all personnel.

SUMMARY

When incident communication is effective, information has been given in a clear and concise manner and has been received and understood.

Effective incident communication is needed to improve firefighter safety, make effective use of resources, improve interagency cooperation, reduce liability, and increase accountability.

The steps of the communications model are encoding, transmission through a medium, receiving, decoding, and providing feedback.

Types of tactical communication that occur on the incident include initial size-up reports, implementation orders for the action plan, progress reports, reports on safety hazards, evacuation order, and tactical benchmarks.

The major benefit of using the communications model is the assurance that messages have been received and understood.

COMMUNICATIONS

Effective communication is the basis of good incident management, and faulty communication is the cause of many incident problems.

The purpose of communication is to establish a common or mutual understanding of meaning. Words are arbitrary symbols and have multiple meanings based on prior experience and knowledge of the individual. Communication can only take place if common understanding is established.

The communication process is a chain whose elements include the formation of ideas into messages by the sender and the sending of the message by the sender through a medium, where a second person receives it. The message is then interpreted and translated into action by the receiver (hopefully in the way intended by the sender). It is important that feedback be given the sender to be sure that the receiver understands the message.

Breakdowns in the communication process are the result of poorly organized thoughts, poor speech, noise and other distractions, bad hearing, unfamiliar words and experiences, interruptions, or time pressures.

Listening

Listening is the active, conscious process of receiving, interpreting, and understanding the spoken message. In order to strengthen listening skills, the CO must see listening as desirable and have a readiness to listen and an eagerness to understand.

- Suggestions for improving listening skills include:
- Try to find the purpose of every listening situation.
- Physically and mentally concentrate on listening effectively.
- Be patient--one can listen faster than one can speak.
- Stop talking.
- Minimize distractions.

Interpersonal Communications

Through training and using standard procedures at each emergency, the IC needs to sharpen and develop interpersonal communication skills. As the leader, the IC can instill confidence in the decisions that are made and in subordinates who must carry them out by using effective interpersonal communications. "Command presence" is a term that conjures up an image of a person in control of the situation. Through stance, voice inflection, tone, volume, octave level, and setting the example in all procedures, the IC can have a reassuring impact on all those involved in the emergency. Both success and failure are contagious and the IC can be the source of either. The cumulative effect of poor communication skills will be a lack of leadership. In the absence of leadership, chaos can fill the void quickly.

Self-Confidence

To realistically expect subordinates to have confidence in decisions, the IC must first respect and have confidence in the decisions they make. The action plan they develop may, in retrospect, not be perfect but if subordinates believe the plan will work, their aggressive actions will usually overcome any minor shortcomings the plan may have. Short, precise statements given the IC, containing the essential information, contribute to better understanding and reduce the chance for confusion or misunderstanding. Brevity in radio transmissions does not indicate a lack of leadership, but rather can convey decisiveness.

Radio Discipline

A major tool in communication is the radio. It is imperative that the CO establish and promote appropriate procedures in the use of the radio at all times, particularly on the incidents. Many of the methods and procedures also apply in the use of the telephone.

At most emergencies, the adrenalin level of the responders can lead to communication problems that seriously affect the effectiveness of the operations. Everyone with a radio thinks what he/she has to say is more important than what anyone else has to say. This all too often results in a breakdown of radio discipline. Everyone is trying to talk at once. Messages do not get acknowledged, transmissions are cut off, all messages have equal priority, lines of communication become crossed, and control of the scene is lost.

UNDERSTANDING INCIDENT COMMUNICATIONS

Feedback

Communication is only effective when it is two-way. During the initial stages of an emergency, a large amount of radio traffic usually needs to take place. The bulk of the orders are given, information concerning the situation is being gathered and passed along to the responders, and the excitement level is at its peak. Unless proper discipline is maintained, messages get lost in the crush of radio traffic. Critical to any transmission is an acknowledgment the message has been received. Just because the IC transmits to Engine 1 to take a handline to Side "B" of the building for exposure protection, this does not mean Engine 1 heard the order and will carry it out. Feedback needs to come back to the IC that Engine 1 has received and understood the message. That feedback could be assured if the following radio traffic took place:

IC: "Engine 1, This is Command."

Engine 1: "Command, This is Engine 1."

IC: "Protect Exposure C with a handline."

Engine 1: "Protect Exposure C with a handline."

IC: "Affirmative."

In less than 10 seconds, the IC has confirmation that Engine 1 has received and acknowledges what the IC was trying to say. Without that two-way communication taking place, the IC might well be confining the fire in Side "B" of the building and arguing later with the officer on Engine 1 why the exposure line was never placed in service on Exposure C.

Ongoing Feedback

The feedback needs to be ongoing throughout the incident. Using this same example, Engine 1 needs to advise the IC when the order has been carried out:

Engine 1: "Command, This is Engine 1."

IC: "Engine 1, This is Command."

Engine 1: "Handline in place on Exposure C."

IC: "Handline in place on Exposure C."

Engine 1: "Affirmative."

This lets the IC know the order has been complied with. Engine 1 should tell the IC if they are unable to meet their objective and need additional lines.

The helpless feeling many incident commanders experience is the frustration of not getting information back as to how the crews are progressing. The IC needs as accurate a picture as possible of the extent of the emergency, what is involved, and how the forces at hand are able to deal with it. To gain this information, the IC must rely heavily on the feedback provided by personnel. They need to keep the IC updated on whether or not they are meeting their objectives and of additional information they obtain during the course of the incident.

The above communication procedures form a "model" that will provide for effective communications.

Need for Training

Don't expect radio communications to flow without problems during the high stress atmosphere of an emergency if no training program has been provided to teach personnel proper procedures and use of equipment. Departments need to spend time developing radio procedures that address their needs and establish how communication is to be handled among the agencies with which they function. Time needs to be spent in the controlled surroundings of a training session working on proper use of procedures, improving radio discipline, and proper use of the equipment.

Strange things can happen to people when a microphone is placed in front of them. A lawyer driving a Mercedes Benz may start talking like a long-haul trucker on his CB. Some fire officers are struck mute when required to talk over a radio. Skills need to be developed through training so that they come naturally during the stress of an emergency. Proper procedures and skills should be practiced on all emergency scenes and be the standard rule of the department.

THE NEED FOR EFFECTIVE INCIDENT COMMUNICATIONS

Effective Use of Resources

For an IC to manage an incident capably, the action plan needs to be conveyed in a manner that is clearly understandable to subordinates, with an emphasis on brevity. The IC's ability to communicate orders succinctly and clearly eliminates confusion and gives subordinates defined boundaries in which to operate. This drastically reduces the chance or need for firefighters to function independently or to freelance. A well-communicated action plan keeps emergency personnel functioning as part of the team, and maximizes the capabilities of the tactical resources with which the IC has to work.

The emergency scene is dynamic in nature, not static. It is constantly changing. If the IC is to have an accurate picture of what is going on, the information needs to flow back from subordinates. Procedures need to be established outlining when and how this information is to be transmitted back to the IC. Without periodic updates on how crews are progressing, the IC can be left in the dark, unable to react properly to the changing conditions. Once again, this information should be transmitted in a clear, concise manner.

In looking at problems with emergency communications and the need for procedures, skills, and discipline, one classic example of why poor practices lead to poor scene management can be found in compulsive talkers. They can be identified by the following characteristics:

- Key microphone prior to knowing what they are going to say. (Dead air often filled with "uh---uh---.")

- Broadcast messages whose meanings are either vague, of little importance, repetitive, or rambling. Most likely, all of the above.

- Ask numerous questions, the answers to which serve mostly to delay operations. This ties up the radio channel so that others are unable to get in any messages.

If you know a compulsive talker, you can probably add to the list of characteristics. It should be noted that good communications skills, procedures, and training can correct this.

Personnel Safety

Paramount on the list of the IC's responsibilities is the safety of personnel. Effective communication allows the IC to know where personnel are at all times. It allows for coordinated tactical operations so that no one crew is operating beyond the scope of the overall plan and the support of other crews. Personnel can be advised quickly of any safety hazards that may exist at the scene. Swift reaction and attention to any medical emergency can result from effective lines and methods of communication.

In the back of every IC's mind is the fear that one of the personnel will be killed or injured. By using proper communications throughout the emergency scene, the fear can be reduced and the safety of personnel protected.

Improved Interagency Cooperation

Good communication practices make your department look good. Radio communication may be the only contact you have with other agencies. How well you communicate may be the basis on which they judge your department. Effective communications makes it easier for other agencies to understand your needs, thus improving their value to you. Effective communications helps eliminate duplication of efforts among agencies operating at the same incident.

THE NEED FOR A COMMUNICATIONS MODEL

Establish Procedures

The first step in the establishment of a program to upgrade a department's communications should be a set of standard procedures. These written procedures should include lines of communication, what frequencies to use, and when to use them. Equipment designations, a standard set of words and phrases, a method of alerting personnel of hazardous conditions at an emergency scene, preventive maintenance for radio equipment, and proper use of the radios should be included.

For procedures to be most effective they should be compatible with other emergency service agencies with which a department is likely to work. This will require cooperation and compromise on the part of all agencies involved. Looking at when agencies need to be included, keep in mind that the "real world" is capable of outdoing most "worst case scenarios" used in planning. Every effort should be made to include as broad a region as possible in your cooperative group.

Once procedures are established, training should begin immediately. The training will not only help the personnel on the department understand the system but will also give a good indication of any weakness or changes which need to be made in the procedures. Periodic training with the other emergency agencies should also be done to assure compatibility.

When the procedures are in place and the training has been conducted, the department will have the opportunity to hold personnel accountable for conforming to established standards. It is much easier to play the game right if someone lays out the rules. By instituting procedures and providing training, the department gives personnel a set of rules to follow. What should be remembered is: "perfect practice makes perfect." When personnel understand the procedures and have been trained in their use, the procedures will come automatically during an emergency.

Establish Communications

The need for an area-wide communications system is best demonstrated during a natural disaster that affects many jurisdictions. When cities, counties, fire districts, police and sheriff's agencies, and disaster offices are all engaged in combating the same emergency, the need for coordinated communications is critical. Any time life or property is threatened and more than one agency is involved, the need for coordinated communication is just as great, but on a smaller scale. It is easy to determine that the police, fire, and ambulance need to interact on a regular basis within their own jurisdictions and need common frequencies and procedures. What is often overlooked is the need for an area-wide plan involving a wide variety of agencies.

In the event of a flood, tornado, hurricane, tank car derailment, large wildland fire or other disaster, a multitude of agencies will be involved. It is possible that the most important thing to a fire department might be a piece of heavy equipment which is under the control of the county road department. As time is always a critical factor, the communications system among the departments should be in place prior to the emergency. When planning your system, thoroughly analyze what agencies could be involved in a large-scale emergency. They should be included in your plan along with an inventory of their capabilities and equipment.

Compatible Hardware

A significant benefit of an area-wide communication plan is that the agencies involved can band together for their mutual advantage in several areas. If a consensus can be reached on the selection of compatible hardware, group purchases can help reduce cost of equipment. Because of the costs incurred from duplicating service, many jurisdictions have combined dispatching facilities. Some share a building with each retaining separate dispatchers. Others have become multiagency communication centers, either sharing or rotating dispatchers. Sharing of frequencies, repeater towers, training for dispatchers, and training materials can all be done within a regional system.

Clear Text

Earlier, we mentioned the confusion caused by the use of codes. Many agencies and organizations have eliminated this problem by the use of "clear text." In lieu of codes, a standard set of words and phrases is used. This removes the chance for misunderstanding and misinterpretation of codes.

"Affirmative."

"Negative."

"Engine 3 on scene" (at address).

"Unreadable."

"Report on conditions."

Resource Designators

In conjunction with the regional communications plan, a standard set of resource designators should be established. Terminology and equipment vary from department to department; it is important that a common understanding be developed of what calling for a particular resource will bring. One department may staff their engines with an officer and three firefighters while another will put an engine in service with only a driver, relying on volunteers to fill the crew at the scene. It needs to be predetermined among the agencies just what is meant by each resource designation.

As with the communications plan, the resource designators should be confirmed through cooperation and compromise on the part of the agencies involved. The Incident Command System (ICS) has a published list of standard resource designators which may serve as a basis for a region developing their designations. It could serve as a solution to such problems as to whether the truck with lots of water is a tanker, water wagon, or water tender.

Once developed, shortened versions are then used for radio call signs which allow for easy identification of resources.

Primary Mobile Suppression Resource Designators

Resource	Radio Call	Description
Engine Company	Engine	A vehicle carrying hose and a pump. A Class A pumper is typically used.
Truck Company	Truck	An aerial apparatus or unit carrying additional ground ladders or otherwise designated to perform truck company operations.
Water Tender/ Tanker	Water Tender/ Tanker	A vehicle that carries a large quantity of water to support the engine company.
Rescue Medical	Rescue Ambulance	Ambulance.
Medic	Medic	Vehicle carrying medical personnel without transport capability.
Brush	Brush	A vehicle designed for off-road use at wildland fires.
Rescue Company	Rescue	A vehicle carrying special tools and equipment to function in rescue situations.

Face-to-Face

When possible, use face-to-face communication. Face-to-face communication is the most effective form that can take place. It is much easier to convey the message when the person on the receiving end can see the facial expression, hand gestures, and other nonverbal messages the speaker is sending out. The speaker is better able to tell if the message is being received. A blank stare on the part of the person hearing what is being said is not nearly so reassuring as when his/her head is nodding in acknowledgment. The blank stare will indicate to the sender that he or she may need to clarify or expand on what was said. Failure on the part of an IC to recognize the need and effectiveness of face-to-face communication will eliminate the most productive line of information exchange at his/her disposal.

Another advantage of face-to-face communication is the ability to ask questions and seek clarification. For some reason, it is much easier to ask questions face-to-face than over a radio. It may be the fear of possibly asking a "dumb question" which is heard by the entire network or, rather than tie up additional air time, guessing at the meaning. Whatever the reason, face-to-face communication flows more naturally and is easier to understand.

Incident commanders should realize the importance of face-to-face communication, not only because it is the most effective way to pass information, but for the opportunity to have personal contact with key individuals. The IC can use the encounter to build confidence in those who must carry out the directions. It can also boost the spirits of the IC by knowing that worthwhile communication has taken place and has been clearly understood.

Use of Aides

What frequently happens at an emergency is that the IC becomes the head radio operator and spends much of the time on the radio responding to a multitude of transmissions. If extra personnel are available, an aide can be used to screen radio traffic, log information as to the status of companies, handle traffic from the communications center, and relieve the IC of all but the transmissions necessary to carry out the action plan.

Use of Runners

When there are problems with communication due to lack of radios, noise levels, or physical barriers, runners can be used to relay messages.

Not only can runners relay messages, but they also can advise the IC of what they saw. This lends another set of eyes and perceptions. Messages carried by the runner can be either verbal or written. If the IC wants to minimize the risk of error, the commander may wish to write brief messages. While delivering messages, the runner should use a notebook to jot notes concerning the communications the IC wants delivered.

THE COMMUNICATIONS MODEL

The model is a six-step process.

Training in the use of the model makes communication a matter of habit and it also develops confidence in your ability to communicate effectively.

Step one: The sender formulates an idea that he/she wants to convey to another person.

Before attempting to send the message, the sender must have clearly in mind what message is to be conveyed. It is very difficult to make a message clear to others until it is clear in your own mind.

Messages must be concise. Eliminate information that is not essential to the message you are trying to impart. The more information that is included, the greater the chance that important parts will be lost. If it is necessary to send a long message, send it in manageable parts. If the demands of the incident are interfering with your ability to formulate your messages, you must delegate to get back within the span of control. Formulation of ideas takes place in the brain.

Step two: Sender sends message.

The first part of sending the message is getting the attention of the intended receiver. The second part of sending the message is actually conveying the message.

Differences in word meaning are a major source of communication failure. An example is the word "charge." You charge someone a fee for doing a service, you charge a purchase when you want to pay later, you charge a battery when you want it to provide electricity, you charge a horse into battle against the enemy, you get a charge out of something funny, you put a powder charge in a cannon, and you charge a criminal with crimes.

Discourage use of ten codes and pet names for apparatus, equipment, or buildings Use clear text and standard resource designators. Clear text is a standard set of words and phrases used as part of your ICS. Standard resource designators consist of standardized terminology used to identify apparatus and equipment.

In the case of written communication, sending occurs when words are written.

In oral communication, it is spoken words that are sent.

Step three: Transfer the message through the medium.

Types of media include verbal (face-to-face), and radio. If written, can the other person read it? Written media are often used at major incidents covering a long period of time.

Visual media include hand signals, signs or symbols (nonverbal), body language, and expressions and gestures.

Training should include proper use of equipment. Outside interference in the form of noise or confusion should be minimized. Equipment maintenance and purchase must have a high budget priority because of the importance of communications to safety and effectiveness. Examples of media by which written communication is transferred include memos, letters, and fax. Oral communication can be transferred by direct conversation, radio, telephone, etc.

Step four: The receiver receives the message.

The first part of receiving the message involves letting the sender know you are ready to receive the message. The second part of receiving the message is actually receiving the intended information. Training and positive reinforcement of good skills should be provided. The receiver should try to minimize background interference. Written communication is received by the eyes and oral communication by the ears.

Step five: The receiver interprets the message.

Training must be provided if the level of understanding of the receiver is not adequate to grasp the sender's meaning. Clear text and standard resource designators provide common terminology. It is possible that the sender may have sent the message incorrectly

or the receiver might have heard it incorrectly. Interpretation takes place in the brain.

Step six: The receiver confirms that the message has been received and understood by providing feedback.

If the message is important enough to send, it is even more important to know that it was received and understood. If there is any confusion or misunderstanding, the sender has the opportunity to correct it. Sender should ask for feedback if it is not provided. Radio traffic is reduced because communications model confirms receipt and understanding immediately through feedback.

Example of Communications Model in action:

Formulation of idea:

Sender: "I want Engine 1 to take 1-3/4" line to second floor." **(Thought)**

Sender: "Engine 1, Command." **(Getting attention of receiver)**

Transfer through medium: **(Radio transfers message from sender to receiver)**

Receiver: "Command, Engine 1." **(I'm paying attention)**

Sender: "Take 1-3/4" line to second floor." **(Conveying information)**

Receiver: "I'm going to have my crew take 1-3/4" line to second floor." **(Thought)**

Receiver: "Taking 1-3/4" line to second floor." **(Feedback that Engine 1 understands assignment)**

Sender: "Affirmative, Engine 1."

Common Communications Problems

There are a number of roadblocks to effective communications. These should be understood and avoided as much as possible. Some roadblocks can only be resolved on a long-term basis, others may be out of the control of the CO. It remains the responsibility of the CO to identify each communication roadblock he/she is unable to resolve and to bring these problems to the attention of his/her superiors through the appropriate channels of authority.

When firefighters get together to tell war stories and talk about the problems they face, one of the major stumbling blocks to their operating at maximum effectiveness will inevitably be the lack of good communications. Communication is acknowledged by ICs to be their number one problem. When we look at the causes and try to determine what needs to be done to improve our emergency scene communications, there are some basic concerns that need to be examined.

Lack of Adequate Communications Equipment

Either through budget restraints or lack of proper planning, many departments are forced to function with equipment that is ineffective or outdated. Radios that will transmit but will not receive, old tube-type radios that require one hour of service for each half-hour of use, lack of enough portable radios, departments forced to use CB radios for emergency operations, not enough base stations, pagers, repeater sites, and a multitude of other hardware limitations prevent emergency personnel from communicating effectively. Whatever other problems departments may have in communicating, there will continue to be problems until they identify the shortcomings of their current hardware, and address a means of acquiring sufficient functional equipment.

Lack of Adequate Emergency Frequencies

Another limiting factor a great many departments face today is the lack of an adequate number of emergency frequencies. Many departments share a frequency with other agencies or groups of agencies. It is not uncommon to find fire, police, street department, water, sewer, and any other agency with a radio, all sharing the same radio channel. In the event of an emergency it is not always possible to convince those agencies not involved to forego the use of the radio frequency they share. Personnel at an emergency may find themselves competing for air time with the sewer department's effort to find out why their sewers in town are backing up. Both feel they have a priority need.

For those departments having their own frequency, there can still be significant problems if no tactical frequencies are provided. If administration radio traffic, simultaneous alarms in progress, and alarm paging are all done on the same frequency, confusion will occur. Separate tactical frequencies need to be obtained so that emergency scene communications can be made without the interruptions and confusion caused by other radio transmissions. As a department grows, more tactical frequencies should be added so the possibility of multiple calls running at the same time on the same frequency is not a regular occurrence.

Mix and Match Frequencies

Unless you happen to own the only piece of emergency equipment on a distant Pacific island, there is a need to communicate with other agencies. What we typically find when there are multiple agencies operating at the same emergency scene is each agency with its own frequency. For example, police are unable to talk to fire, fire has no means of talking to the ambulance, and the ambulance is incapable of talking to the mutual-aid fire department that just arrived. One agency is high band, another low band, another VHF, and the one agency with the big budget is trying to talk to everyone else in the 800 MHz range. What is lacking, in addition to planning and coordination, is a common frequency or plan that would allow emergency responders to communicate among themselves.

Incompatible Radio Codes

Any department has its choice of a multitude of radio codes. Several national organizations, state agencies, and local jurisdictions publish their own codes. More than one department uses the code that came with its CB radios. What may be an "accident with injuries" using one code can be "a dead animal in street" using another. Many departments use codes particular to their own agency. The department may design these to cover its own seemingly unique activities, or activities it does not want made known to all area scanner owners. The end result is a wide variety of radio codes in use at a multiple-agency response. This can be not only confusing, but dangerous. The use of codes should be kept to an absolute minimum. A standard set of words and phrases should be used to eliminate confusion and assure messages are understood and acted upon.

Need for Common Terminology

The fire service has a language of its own, but different departments and different parts of the country may speak a dialect not completely understandable to someone from another department or area. A truck carrying lots of water may be a water tender in one department, a tanker in another, or a water wagon in yet another. It's a booster line in Colorado but you had better call it a red line in Texas. That tanker may be a truck with lots of water in some parts, but in others it's an airplane loaded with retardant. When departments work together, there must be a mutual understanding of terms. There is no reason or excuse to ask an adjoining department for a tanker and be surprised when an airplane shows up. The understanding needs to occur prior to the emergency, in meetings between the agencies. An emergency scene is a poor location at which to do planning or training.

BENEFITS OF USING THE COMMUNICATIONS MODEL

The fire service across the country enjoys the reputation of dedicated public servants. One way to improve and enlarge that reputation is by projecting a professional image in the way communications are handled. Other emergency service and governmental agencies will use communications as one of the measures by which to judge your department. When a representative from another emergency agency views your department as being highly capable, cooperation is easier to receive. In addition, you have recruited a supporter who enjoys public credibility.

It is important to any department's growth to have the support of the community. With so many scanners now in use in cars, homes, and carried as portables, few, if any, radio transmissions go unnoticed. What the public hears may likely be the only contact you have with the majority of them, and communications will be the sole criterion upon which they evaluate your department.

TACTICAL COMMUNICATIONS RESPONSIBILITIES

When communication breaks down on the incident so do coordination, control, and the ability to provide for firefighter safety.

All personnel have the responsibility to communicate effectively. This starts with a good brief initial report by the first-in officer, and continues throughout the incident.

There are different types of tactical communications including: initial conditions reports, implementation orders of the action plan, progress reports from officers who are responsible for meeting the action plan, reports of safety hazards or evacuation orders, and tactical benchmarks.

It is important to communicate the completion of tactical operations addressing specific incident priorities. These are: life safety, incident stabilization, and property conservation.

Completion of primary search (life safety priority) allows a shift of emphasis in tactical operations to incident stabilization. "**All Clear**."

> Resources confining the fire to permit search operations can now be applied to extinguishment.

Stopping the forward progress of the fire allows the IC to shift resources to property conservation. "**Under Control**."

> Some resources assigned to fire attack and ventilation may be reassigned to overhaul and property conservation.

When further property loss is stopped, the IC can begin the process of demobilization. "**Loss Stopped**."

> Resources can be made available and returned to service.

Progress reports from COs. "**Report on Conditions**."

> The tactical operations to which they were assigned are having a positive impact. (Good news.) Assigned tactical operations are not having a positive impact and why. (Bad news.)
>
> Let your immediate supervisor know the nature of the problem. Try to offer a solution to the problem, along with the bad news, since you are usually in the best position to make that determination.
>
> Additional resources that may be needed include: additional crews to assist with the tactical operation, and any additional or specialized equipment.
>
> Advance warning to the supervisor is needed when relief crews will be required and if and when resources might be available for release or reassignment, and periodic reports on the status of the incident and assigned resources.

Reports of safety hazards or evacuation orders. "**Emergency Traffic**."

All personnel have the responsibility to communicate when safety hazards are identified that may adversely affect firefighter safety or the tactical operation.

A method to quickly convey emergency information should be established through standard operating procedures. Written procedures should include a method to quickly convey this information to everyone on the incident. These should be included as an important part of your department's communications training. Written procedures should also include methods, in addition to radio communications, to notify personnel of imminent danger and of the need to evacuate to safety. These can include: blasts on the air horns, sirens, PA systems, and anything loud and easily understood by all personnel.

Departmental procedures should include a method which accounts for all personnel when the structure has been evacuated: designated reporting locations, radio checkoff system, and confirmation by supervisors that all personnel are accounted for.

ACTIVITY 3.1

COMMUNICATION

Part 1 - One-Way Communications

Purpose:

This part of the activity is intended to allow you to examine the effectiveness of one-way communications in giving directions.

Directions:

The task is to draw a picture of a group of geometric shapes in a particular pattern.

Only one-way, verbal communications will be used. Gestures and illustrations cannot be used to facilitate the process of giving instructions.

One member of the class will be provided with a drawing. That individual will provide clear and concise instructions to the group on how to construct a copy of the drawing.

In the space below, construct the drawing according to your fellow student's instructions:

ACTIVITY 3.1 (cont'd)

COMMUNICATION

Part 2 - Two-Way Communications

Purpose:

This part of the activity is intended to allow you to examine the effectiveness of two-way communications in giving directions.

Directions:

The task is to draw a picture of a group of geometric shapes in a particular pattern.

Two-way, verbal communications will be used. Ask questions and provide feedback to ensure that you understand the directions. Gestures and illustrations cannot be used to facilitate the process of giving instructions.

One member of the class will be provided with a drawing. That individual will provide clear and concise instructions to the group on how to construct a copy of the drawing.

In the space below, construct the drawing according to your fellow student's instructions:

30 min.
Large Group
Activity 3.1
Slide 3-12

SM p. 3-29

ACTIVITY 3.1

EFFECTIVE INCIDENT COMMUNICATIONS

Purpose:

This activity is intended to reinforce the importance of effective incident communications and compare the incident with course material just covered. **It is not intended to be used as a critique of the fatal incident that claimed five lives**, but only to reinforce the importance of effective emergency incident communications.

Directions:

After viewing a videotape of a fire, identify areas where improvement could be recommended for the following:

1. How could better communications have improved firefighter safety?

2. Did communications allow for resources to be effectively used?

3. How could communications have been improved to change from offensive (inside the building) to defensive (outside the building) operations?

4. How could communications at the incident affect future legal actions?

Summary:

The importance of communications, standard operating procedures, and established safe practices will greatly enhance a safe and effective operation.

It is extremely important that communications be received, understood, and repeated for safe and effective operations.

STUDENT ACTIVITY WORKSHEET

ACTIVITY 3.1

EFFECTIVE INCIDENT COMMUNICATIONS

Purpose:

This activity is intended to reinforce the importance of effective incident communications.

Directions:

After viewing a videotape of a fire, identify areas where improvement could be recommended for the following:

1. How could better communications have improved firefighter safety?

2. Did communications allow for resources to be used effectively?

3. How could communications have been improved to change from offensive (inside the building) to defensive (outside the building) operations?

4. How could communications at the incident affect future legal actions?

ACTIVITY 3.2

APPLICATION OF THE COMMUNICATIONS MODEL

Purpose:

The purpose of this activity is to provide you with an opportunity to apply the communications model to incident operations.

Each group should select a spokesperson to play the role of the CO.

Directions:

The instructor will provide you with dispatch information about an incident. You will then be shown a slide of the structure fire you are responding to. The dispatch to the alarm will include Engine 1, Engine 2, and Truck 1. Engine 1 will be the first on the scene and the CO of Engine 1 will be the IC. Engine 1 will transmit "an arrival report" and then transmit tactical assignments to Engine 2 and Truck 1. Engine 2 and Truck 1 will acknowledge their tactical assignment using the communications model.

Using the activity worksheets, each group should prepare an arrival report and prepare to transmit the tactical assignments to the two other responding units.

After three minutes to prepare your arrival report the instructor will designate a group to be Engine 1, Engine 2, and Truck 1. Engine 2 and Truck 1 officers should acknowledge the IC's tactical assignment using the "Communications Model."

ACTIVITY 3.2 WORKSHEET

RESPONSE ONE

Engine 1 is on the scene and has the following: _____

_____

_____

_____

_____

TACTICAL ASSIGNMENTS

Select one of the tactical assignments from the list below to transmit to Engine 2 and Truck 1 should your group be selected to role-play as Engine 1.

TACTICAL ASSIGNMENTS FOR ENGINE 2 - SELECT ONE

_____ Confine the fire to the area of origin.

_____ Bring in a backup line to backup Engine 1.

_____ Check for extension above the fire.

_____ Develop a water supply of 500 gpm.

TACTICAL ASSIGNMENTS FOR TRUCK 1 - SELECT ONE

_____ Perform primary search of floor above fire.

_____ Perform vertical ventilation.

_____ Ladder building for secondary means of egress.

ACTIVITY 3.2 WORKSHEET (cont'd)

RESPONSE TWO

Engine 1 is on the scene and has the following: _____

_____

_____

_____

_____

TACTICAL ASSIGNMENTS

Select one of the tactical assignments from the list below to transmit to Engine 2 and Truck 1 should your group be selected to role-play as Engine 1.

TACTICAL ASSIGNMENTS FOR ENGINE 2 - SELECT ONE

_____ Confine the fire to the area of origin.

_____ Bring in a backup line to backup Engine 1.

_____ Check for extension above the fire.

_____ Develop a water supply of 500 gpm.

TACTICAL ASSIGNMENTS FOR TRUCK 1 - SELECT ONE

_____ Perform primary search of floor above fire.

_____ Perform vertical ventilation.

_____ Ladder building for secondary means of egress.

ACTIVITY 3.2 WORKSHEET (cont'd)

RESPONSE THREE

Engine 1 is on the scene and has the following: _____

_____

_____

_____

_____

TACTICAL ASSIGNMENTS

Select one of the tactical assignments from the list below to transmit to Engine 2 and Truck 1 should your group be selected to role-play as Engine 1.

TACTICAL ASSIGNMENTS FOR ENGINE 2 - SELECT ONE

_____ Confine the fire to the area of origin.

_____ Bring in a backup line to backup Engine 1.

_____ Check for extension above the fire.

_____ Develop a water supply of 500 gpm.

TACTICAL ASSIGNMENTS FOR TRUCK 1 - SELECT ONE

_____ Perform primary search of floor above fire.

_____ Perform vertical ventilation.

_____ Ladder building for secondary means of egress.

ACTIVITY 3.2 WORKSHEET (cont'd)

RESPONSE FOUR

Engine 1 is on the scene and has the following: _____

_____

_____

_____

_____

TACTICAL ASSIGNMENTS

Select one of the tactical assignments from the list below to transmit to Engine 2 and Truck 1 should your group be selected to role-play as Engine 1.

TACTICAL ASSIGNMENTS FOR ENGINE 2 - SELECT ONE

_____ Confine the fire to the area of origin.

_____ Bring in a backup line to backup Engine 1.

_____ Check for extension above the fire.

_____ Develop a water supply of 500 gpm.

TACTICAL ASSIGNMENTS FOR TRUCK 1 - SELECT ONE

_____ Perform primary search of floor above fire.

_____ Perform vertical ventilation.

_____ Ladder building for secondary means of egress.

ACTIVITY 3.2 WORKSHEET (cont'd)

RESPONSE FIVE

Engine 1 is on the scene and has the following: _____

_____

_____

_____

_____

TACTICAL ASSIGNMENTS

Select one of the tactical assignments from the list below to transmit to Engine 2 and Truck 1 should your group be selected to role-play as Engine 1.

TACTICAL ASSIGNMENTS FOR ENGINE 2 - SELECT ONE

_____ Confine the fire to the area of origin.

_____ Bring in a backup line to backup Engine 1.

_____ Check for extension above the fire.

_____ Develop a water supply of 500 gpm.

TACTICAL ASSIGNMENTS FOR TRUCK 1 - SELECT ONE

_____ Perform primary search of floor above fire.

_____ Perform vertical ventilation.

_____ Ladder building for secondary means of egress.

ACTIVITY 3.2 WORKSHEET (cont'd)

RESPONSE SIX

Engine 1 is on the scene and has the following: _____

_____

_____

_____

_____

TACTICAL ASSIGNMENTS

Select one of the tactical assignments from the list below to transmit to Engine 2 and Truck 1 should your group be selected to role-play as Engine 1.

TACTICAL ASSIGNMENTS FOR ENGINE 2 - SELECT ONE

_____ Confine the fire to the area of origin.

_____ Bring in a backup line to backup Engine 1.

_____ Check for extension above the fire.

_____ Develop a water supply of 500 gpm.

TACTICAL ASSIGNMENTS FOR TRUCK 1 - SELECT ONE

_____ Perform primary search of floor above fire.

_____ Perform vertical ventilation.

_____ Ladder building for secondary means of egress.

ACTIVITY 3.0

EFFECTIVE FIREGROUND COMMUNICATIONS

Purpose:

This activity is intended to reinforce the importance of effective fireground communications.

Directions:

After viewing a videotape of a fire, identify areas where improvement could be recommended for the following:

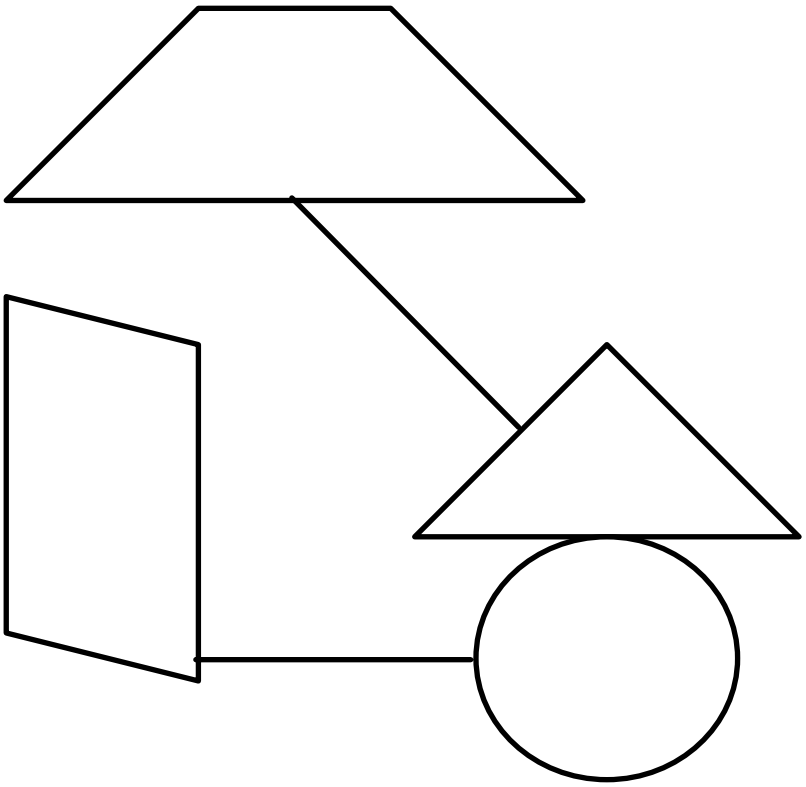
A. Improve firefighter safety.

B. Use resources effectively.

C. Improve interagency cooperation.

D. Mitigate liability concerns.

ACTIVITY 3.1



ACTIVITY 3.1

EFFECTIVE INCIDENT COMMUNICATIONS

Purpose:

This activity is intended to reinforce the importance of effective incident communications.

Directions:

After viewing a videotape of a fire, identify areas where improvement could be recommended for the following:

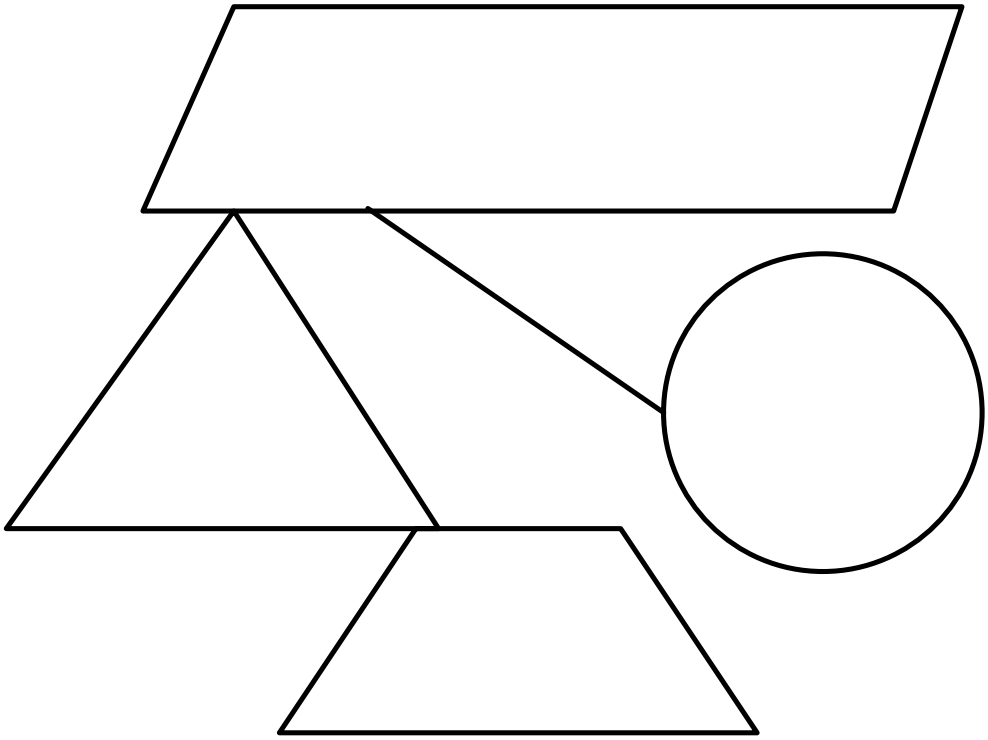
1. How could better communications have improved firefighter safety?

2. Did communications allow for resources to be used effectively?

3. How could communications have been improved to change from offensive (inside the building) to defensive (outside the building) operations?

4. How could communications at the incident affect future legal actions?

ACTIVITY 3.2



ACTIVITY 3.3

SENDER OF MESSAGE

GET ATTENTION OF MESSAGE RECEIVER - EXAMPLE: ENGINE 2 - THIS IS COMMAND
COMMUNICATIONS MODEL

STEP 1: ENCODE MESSAGE - WHAT DO YOU WANT TO SAY
STEP 2: TRANSMIT MESSAGE
STEP 3: PROPERLY USE TRANSMISSION MEDIUM (RADIO, ETC.)
STEP 4: RECEIVER RECEIVES MESSAGE
STEP 5: RECEIVER DECODES MESSAGE
STEP 6: RECEIVER REPEATS/CONFIRMS MESSAGE TO SENDER
STEP 6: SENDER CONFIRMS CORRECT MESSAGE

VOLUME

RECEIVER OF MESSAGE

SENDER GET'S YOUR ATTENTION
COMMUNICATIONS MODEL

STEP 4: RECEIVER RECEIVES MESSAGE
STEP 5: RECEIVER DECODES MESSAGE
STEP 6: RECEIVER REPEATS/CONFIRMS MESSAGE TO SENDER
(IMPORTANT - IF UNABLE TO PERFORM TASK, INFORM SENDER IMMEDIATELY)

SQUELCH

MODULE 4: BUILDING CONSTRUCTION AND FIRE BEHAVIOR FACTORS

OBJECTIVES

The students will:

1. *List the five classifications of buildings and explain the characteristics of each classification.*
2. *Identify the strengths and concerns for each building construction classification.*
3. *List and explain the critical fire behavior factors that relate to tactical operations for an assigned fire scenario.*

NOTE-TAKING GUIDE

BUILDING CONSTRUCTION CLASSIFICATIONS

Understanding the strengths, concerns, and specific characteristics of the varied construction types is critical to safe and effective operations.

Buildings may be grouped into one of five common classifications, or a combination of two or more.

Fire-resistive construction.

Strengths.

Concerns.

Noncombustible construction.

Strengths.

Concerns.

NOTE-TAKING GUIDE

Heavy-timber (mill type) construction.

Strengths.

Concerns.

Ordinary construction.

Strengths.

Concerns.

Wood-frame construction.

Post and beam.

Strengths.

Concerns.

NOTE-TAKING GUIDE

Balloon.

Strengths.

Concerns.

Platform.

Strengths.

Concerns.

Lightweight design can be found in many construction types.

Floors/Roof assemblies.

FIRE BEHAVIOR FACTORS

The successful and safe outcome of a fire incident depends on accurate and proactive decisions about fire behavior and structural stability.

NOTE-TAKING GUIDE

Heat release.

Thermal stratification.

Rollover.

Flashover.

Flashover prevention.

Backdraft.

Backdraft prevention.

FIRE TRAVEL PREDICTIONS

The travel of fire in structures can be predicted based upon many factors.

NOTE-TAKING GUIDE

How fires extend.

Need to predict fire travel.

Predicting fire travel can be accomplished by assessments such as:

SUMMARY

Building constructions are classified in five types, or they may be a combination of the five.

Accurate prediction of fire behavior factors can result in effective fire-scene management.

BUILDING CONSTRUCTION CLASSIFICATIONS

Basic knowledge of how buildings are constructed and how they will react when subjected to fire is of vital importance to every fire officer. A building that is on fire is physically being destroyed. The mission of the fire officer is to determine if it is possible to enter the structure, how long the structure can last under fire conditions, and what strengths the building can offer or what weaknesses may exist. Each type of building will react differently under fire conditions, and certain predictions can be made. As an example, a wood-frame building with a lightweight roof structure of truss rafters can be expected to lose its structural strength faster than a building with a roof structure of standard rafter and ridge board design.

Construction Classifications

Generally, it is not possible to distinguish construction classifications from the exterior of a building. Most often, even the experienced observer must look at the bearing members (wall, floor, and roof assemblies) in order to tell the construction classification. At the end of each section describing different construction classifications we will provide a brief summary describing cues and rules of thumb that correspond with that classification.

Fire-resistive is a method of construction where all key structural elements that hold the building up will withstand normal fire conditions for a minimum of three hours. The structural elements generally will be reinforced concrete or steel with a fire protection covering applied. In addition the floors will be fire-resistive and designed to limit fire spread. This type of structure has demonstrated fire after fire that it can withstand complete devastation of the contents and still remain structurally sound. While the structural components are a very positive feature, there may be some concerns that a fire officer should be aware of. As an example, fire in many buildings may spread from floor to floor at the area where the outer wall of the building attaches to the floor segments. Many designs provide for a space between the floor and the wall. This area may be closed off with insulation or may be totally open. In addition, the windows are very often the vehicle for fire spread with fire leaping from floor to floor. To manage this problem some architects have staggered the windows or placed eyebrows over the tops of the windows.

Fire-resistive cues--bearing members are either reinforced, poured, or prestressed concrete assemblies or skeletal steel with the steel protected by sufficient layers of drywall or a sprayed-on, fire-resistive coating. Special fire suppression problems for fire officers would include open floor plans, which have large open areas without separations or compartmentation;

limited opportunities for ventilating; and high heat levels inside the structure.

Noncombustible is identified as a method of construction where the structural components will not burn, but may be susceptible to early collapse under fire conditions. The walls may be constructed of steel or masonry with steel floor and roof structure. This steel will be unprotected from the products of combustion and may be vulnerable to early failure. This method of construction is very popular in commercial or industrial structures. While the structural elements will not contribute to the fuel load, unprotected steel will expand as it warms and eventually will not be able to support itself. As it expands, it has the capacity to push walls or to twist and destroy, and may drop the structural members that it was supporting.

The strength of this construction is in the load carrying capacity and the long areas that it can span without support posts. It is an easily constructed type of building with large steel beams or trusses put in place with cranes. Steel is easily attached to other components by bolting, riveting, or welding, and a frame can be assembled quickly. The weakness of this construction is in the reaction to fire conditions where the steel expands and weakens with the potential for collapse. This building is generally considered a candidate for early deterioration under fire conditions. A fire officer must pay close attention to this classification in order to protect the safety of firefighters.

Noncombustible cues--bearing members are made of noncombustible materials such as metal, concrete, stone, etc. Most often these buildings are skeletal steel assemblies where the steel is exposed and unprotected from the effects of fire.

Heavy-timber (mill) is a method of construction utilizing substantial wood structural elements for floor and roof supports along with masonry exterior walls. This method was heavily used in the northeastern United States to construct mills. The mills would often be built near natural sources of waterpower, and would be constructed up to six stories in height. As the exterior walls were constructed of masonry material, they would be wider at the bottom than at the top; walls generally would be smaller for each floor that they were expected to carry. In many of these structures the walls at the ground floor could be up to 36" thick. The structural timber would be a minimum of 8" by 8" and, depending upon the load, they were spaced based upon the load they would be supporting. Under fire conditions the floors and support timbers burn slowly and remain strong for a considerable time. In many of these structures the floors were several inches thick to support heavy machinery and goods. To minimize water damage to floors below, the floors would be equipped with scuppers.

The strength of this type of building is in the size of the wooden structural members that held the floor and roof in place, in addition to the masonry

walls. While these buildings often had firewalls with fire doors, they also posed massive fire problems due to large open areas with heavy fire loads, oil-soaked floors, and large quantities of combustible stock. In general, this classification is considered a strong building to work in during fire conditions, but one in which fire can quickly surpass a fire department's ability to suppress.

Heavy timber (mill) cues--these buildings have masonry walls. The floors and roof assemblies are wood. The wooden members are much larger than nominal lumber sizes. Look for a minimum of 4" x 6" wood joists, 6" x 8" wood columns, and thick floor decking.

Ordinary construction is a method of construction that has been termed "Main Street USA." This type of building also gained the name "taxpayer" because the owner would often operate a store on the first floor and live on the second floor. The business would pay the taxes on the property and the utilities while the owner lived in the building virtually free. This building has masonry exterior walls and the floors and roof are wood joist. The structural members for floor joists and roof rafters were often 3" by 10" and typically would span 12' to 14', supported by a post-and-beam arrangement for interior walls. Since many of the streets on which these buildings were constructed were narrow, an effort had to be made to limit collapse of the masonry wall. A technique called "fire cut" would be used, where the end of the floor joist or rafter going into a bearing wall would be cut on an angle so that the bottom of the rafter or joist would be longer than the top. The idea was that when the wood member burned off on the inner portion of the structure it would pull out of the wall and fall into the structure, rather than lifting the wall directly above it and pushing the masonry wall into the street. Through the years these buildings were typically renovated several times with ceilings being dropped, new voids created for new plumbing fixtures, and walls removed between occupancies in order to expand floor space.

The strength of these structures is in the masonry walls and the full-dimension lumber used to construct the floor and roof components. In addition, the floor and roof elements were installed with a fire cut so that they could drop out of the walls without bringing the walls into the street. The number of renovations that the building has had will often cause unexpected fire travel and multiple-floor involvement.

Ordinary (masonry wood joist) cues--these buildings have masonry walls. The floor and roof assemblies are wooden. The floor joists often sit in the masonry walls in sockets that hold the joist ends. To determine whether or not the joists have been firecut, one must normally go to the basement level and examine the first-floor joists where they sit in the wall socket.

Wood-frame is a method of construction where the structural components are framed out of wood. The use of a combustible structural element poses a special concern as it will lose its load-carrying capacity as it burns; eventually gravity will take over and pull whatever it was supporting to the ground.

Post-and-beam is a method of wood-frame construction and is typically used in barn construction. A modern method is called "pole barn" construction, where large pressure-treated poles are set into the ground and the framework of the building is hung from these poles. The poles themselves will last considerably longer under fire conditions than the materials used for the roof or walls.

Balloon is a method of wood-frame construction that was popular when long structural materials were available. The common characteristic of this type of building is that the wall studs extend from the foundation of the structure to the roof. When it was time to attach the second floor, the floor joists were simply nailed to the wall studs. This created an open area the entire length of the wall's studs, and across the floors to the opposite side of the building as well. If a fire got into the walls, ceiling, or floor space it was free to go wherever it pleased. Firefighters often tell of being inside the basements of these buildings and shining a light at the foundation with a fellow firefighter in the attic reporting that they saw the light shining through. The interior walls were generally constructed of wood lath over wood studs with plaster attached; the lath was said to resemble kindling, and was arranged in a very desirable manner for rapid fire extension up through a stud channel.

This structure typically used full-dimension lumber, and had close spacing of structural elements. If a fire officer were not correctly reading the building, he/she could quickly become fooled as the fire worked the building in all directions. Extension must be checked aggressively in this type of structure.

Platform is an open method of construction that has been popular since the late 1940s. The structure is built one floor or story at a time. Each floor has a floor deck, sill plate, wall studs, and a plate at the top of the wall. For a fire to travel from one floor to another through the walls, it has a great deal of material in its path to burn through. More often a fire will find another route of extension. Fire may extend via ventilation shafts for dryer, bathroom, and kitchen vents. Areas around plumbing pipes or heating ducts also will be vulnerable to fire extension. Generally the interior wall construction will use drywall material which is inherently fire-resistive and provides for compartmentation of a fire. The weak components most often will be the floor or roof.

Lightweight methods of construction have become popular, with truss construction or a sandwich-beam method of floor or roof support.

Generally wooden trusses will be made of smaller dimension lumber, and be held together with metal gusset plate fasteners. Under fire conditions the plates may loosen and the structural integrity of the entire component may be lost. Another technique in use today is the process of ripping a 3/8" or 1/2" groove into a two by four and inserting a piece of 3/8" or 1/2" plywood. The size of the plywood is dependent upon the area to be spanned. These are commonly found in floor joists or as rafters on a flat or limited pitch roof, and are even becoming popular in some strip-mall construction.

The strength of this method of construction is the floor-by-floor method of building. A weakness may very well be the lightweight floor or roof design.

Wood-frame cues--wood-frame buildings normally have a masonry foundation with all floor, wall, and roof assemblies composed of nominal-sized lumber. The great percentage of private, detached dwellings are wood-frame construction.

FIRE BEHAVIOR FACTORS

An important part of your job will be the ability to make an accurate fire behavior prediction. Understanding fire behavior factors will assist you greatly in determining what is happening and what is likely to happen. They will have an impact on safety, strategy, and the use of resources. Those factors are:

- Heat release.
- Thermal stratification.
- Rollover.
- Flashover.
- Backdraft.

Heat Release

Heat is described in several ways, all of which bear a definite relationship to each other. In order to better understand the concept of heat, the following definitions are necessary:

British thermal unit (Btu): One Btu is the amount of heat required to raise the temperature of 1 pound of water 1 degree Fahrenheit (F), (when the measurement is performed at 60 degrees F).

Knowledge of the types of materials present in a given fire situation and their heat values is important, and can assist you in determining the amount of water to apply, as well as the behavior of other materials within the environment.

Heat of combustion: The amount of heat that will be released by a substance when it is completely consumed by fire.

There are a number of variables which influence the output of heat from burning materials. Some of these factors are:

- The amount of area of solid combustibles exposed to heat and oxygen (the state of subdivision).
- The area of free surface of the liquid (in case of flammable substances to give off vapor pressure).
- The conductivity of solids (wood, etc.) which can influence the amount of heat given off when materials burn.

Even though the heat values (in Btus) of various materials are not precise, they provide us with necessary information for developing the concepts of "fireloading" and the heat absorption qualities of water. Some examples of the heat of combustion values of various materials are shown in the following table.

Materials	**Btu/lb.**
Asphalt	17,150
Cotton batting	7,000
Gasoline	19,250
Paper	7,900
Polystyrene	18,000
Polyvinyl chloride	7,500 to 9,500
Wood	7,500 to 9,050

Thermal Stratification

Thermal stratification is the layering of heat in a given enclosed area. The ceiling or upper area will be a higher temperature. Floor covering materials are potentially less hazardous than ceiling or wall surfaces.

In the prefire inspection, you should not ignore the degree of combustibility of materials used throughout the occupancy. In the MGM Grand Hotel fire, the use of plastic materials in ceiling areas impacted dramatically on the fire behavior.

The introduction of water through a nozzle will rapidly change the thermal stratification of the enclosed area. In most cases, a thermal balance will occur following the introduction of water. The temperature in the room will equalize.

If the thermal balance is disturbed, temperatures can be raised beyond the point where any victims trapped inside would have a chance of surviving. Wide fogs applied into a room can turn the water into superheated steam, endangering both potential victims and firefighters. Full protective clothing and SCBA are a must for firefighters.

Rollover

The term rollover is used to describe the fire or flame front that is often observed rolling along in front of the materials that are actually burning. As a combustible gas is produced and liberated from combustible materials it must mix with air (oxygen) in order to burn. Since the material that is burning consumes tremendous amounts of air (oxygen) there may be a limited amount of air (oxygen) in the upper levels of the room to support combustion of all the fuel being produced. This fuel rich atmosphere will be pushed in front of the fire by the thermal column of heat from the fire and may not come within its flammable limits for several feet away from the main body of the fire. This is especially true in confined areas such as hallways. Often fire seems to be rolling along at ceiling level at a distance up to 10' to 20' ahead of the main fire. What is actually being witnessed is a fuel rich mixture being pushed well ahead of the fire; when it comes into its flammable limits (mixture of air and fuel gas) it burns. This is often described as the fire rolling over.

Flashover

A very basic definition of flashover is the ignition of combustibles in an area heated by convection and radiation, or a combination of the two. The combustible substances in a room are heated to their ignition point and almost simultaneous combustion of the material occurs. In other words, the entire area is preheated to its ignition temperature and can become fully involved in fire in a matter of seconds.

Some of the warning signs of imminent flashover are: intense heat; free-burning fire; unburned articles starting to smoke; and fog streams turning to steam a short distance from the nozzle.

To reduce the chance of flashover, temperatures need to be lowered quickly by ventilation and water application.

Backdraft

As a fire develops, the combustion process creates an atmosphere that is deficient in oxygen and can lead to the possibility of backdraft occurring. This is also referred to as a smoke explosion. The difference between flashover and backdraft is the amount of oxygen present. In flashover there is adequate oxygen available for combustion, and the fire is free-burning prior to flashover. In backdraft, there is insufficient oxygen for active burning, and the fire is smoldering. It is an oxygen-deficient atmosphere.

Normally, sufficient oxygen is present during most fires so that the conditions leading to backdraft are minimized. However, when oxygen is depleted and the fire begins to smolder, an oxygen-deficient atmosphere is created in the fire area. When conditions like this develop, gases such as carbon monoxide and carbonaceous-particle smoke or suspensions are produced. These are capable of reacting with oxygen.

This poses an explosion threat if oxygen is improperly allowed to enter the structure. The accumulated gases will ignite readily, spreading fire or causing a violent explosion. Due to temperatures in the room, the fuel is evolving into ignitable vapors at or above their ignition temperature. All that is needed is oxygen to complete the fire triangle.

When backdraft conditions are present and oxygen is introduced before the inside pressure is relieved, the resultant explosion can blow firefighters and their hoses to that great fire station in the sky. The potential for backdraft exists in buildings, rooms, attics, or any other confined space. An indication of backdraft is when a fire has depleted the oxygen content in an area, yet has preheated that space above the ignition temperatures of the combustibles in it. Another indicator is hot, heavy smoke issuing from the building (smoke is sometimes described as lazy, or sick-looking). This may be accompanied by dark carbonization on the window glass. In this situation, the building may seem to be breathing (drawing smoke back in the opening followed by expelling smoke from the opening). Backdrafts may occur during the incipient phase as well as the smoldering phase.

Ventilation is the first priority and must precede fire attack under backdraft conditions.

FIRE TRAVEL PREDICTIONS

Heat and Smoke Travel

Checking fire extension requires a knowledge of how fire spreads, along with a knowledge of building construction features and the effects of concealed vertical and horizontal spaces. Whenever and wherever

openings are made, hoselines should be ready. While every effort should be made to minimize damage to the building and its contents, openings have to be large enough for inspection, hose manipulation, and ventilation.

Until determined otherwise, it is a safe assumption that when a working fire exists inside a building, fire has entered concealed vertical channels.

Personnel should be looking for indicators such as blisters and discolorations on walls, smoke patterns at molding, walls hot to the touch, or smoke (or fire) showing around roof features, such as vent pipes, etc. If these are present, checking vertical extension is a must.

The tendency for most fire to travel vertically does not preclude horizontal travel. Fire will follow any path available: void spaces between ceilings and floors, over false or hanging ceilings, around utility conduits, etc. Extension occurs not only within the structure, but also from building to building. Here again, hoselines must be in place prior to opening up these areas. Most of the time, the indicators of fire in these areas are difficult to read, but look for some of the indicators present in vertical spread. These areas should not be overlooked and have been responsible for fatalities, as well as for fires getting out of control.

Tactical operations in large and complex occupancies will have to be carefully coordinated in order to accomplish a reduction or change in heat and smoke travel. Ventilation is a key tactical operation that will affect how, when, and where heat and smoke spread through a structure.

In your prefire inspections and plans, always look at all the possibilities of heat and smoke travel in a specific occupancy. The time of the fire is not the time to study heat and smoke probabilities.

Based on the fire behavior factors and resource capabilities, you must make a fire behavior prediction which answers the following questions:

- Where is the fire at this time?
- In what direction is it likely to spread?
- Is there a probability that flashover is imminent?
- Is there a probability that backdraft is imminent?

- Is collapse likely to occur within the time required for offensive operations?

Once you have the answers to these questions, you have identified the problems and can have a much clearer idea of what the resource needs are.

The travel of fire in structures can be predicted based upon a good understanding of building construction and fire behavior factors. Fire, smoke, and heat travel are dependent upon many factors such as void areas within the structure, the effect of the wind, and the positioning of hoselines.

The building layout and design can be an advantage or a disadvantage to your fire confinement and suppression efforts. Fires in large open areas will generally be more difficult to confine than fires in a compartmented area. Items such as fire load and built-in fire protection features will affect your efforts. Items such as firewalls, fire doors, and automatic sprinkler systems can play a major role in the amount of resources you will need and efforts it will take.

Fires generally spread from room to room via open doorways or through doors that are lightweight and do not last more than a few minutes under fire conditions. Fires generally spread from floor to floor via open stairways or via open shafts and voids.

Fire travel predictions can be made by asking a few basic questions:

- Where is the fire now?

- Where is the smoke showing?

- What is in place to stop the spread of the fire and smoke to other areas of the structure, such as firewalls or other fire resistant materials?

- What signs do I see such as discoloration of paint, bubbling tar, or other building reactions that will provide me with clues as to the fire travel?

The ability to predict fire travel will provide an officer accurate predictions that can lead to successful operations, realistic and proactive decisions, and adjustments as needed.

A good fire officer is an informed officer. An informed officer will be a well trained officer. A well trained officer will be a safe officer. Be careful out there!

ACTIVITY 4.1

BUILDING CONSTRUCTION CASE STUDY

Purpose:

This activity gives you the opportunity to examine an actual fire incident and to determine what construction features contributed to the impact of the fire and the success (or lack thereof) of firefighting operations.

The lack of opportunity to learn by direct experience can be compensated for in part by a critical examination of the experience of others. The examination of these case studies illustrates how this type of information can be used on an individual, company, or department basis as a part of CO training and development.

Directions:

1. Each group must determine the answers to the following questions:

   a. What construction type was involved?

   b. Did the construction type affect fire spread, and if so, how?

   c. Did the stability of the structure under fire conditions affect firefighting operations, and if so, how?

   d. Based on this case study, what effect should this type of construction have on firefighting operations?

2. Appoint a spokesperson and report your findings. The report should include an overview of the incident and the answers to the preceding questions.

ACTIVITY 4.1 (cont'd)

BUILDING CONSTRUCTION CASE STUDY

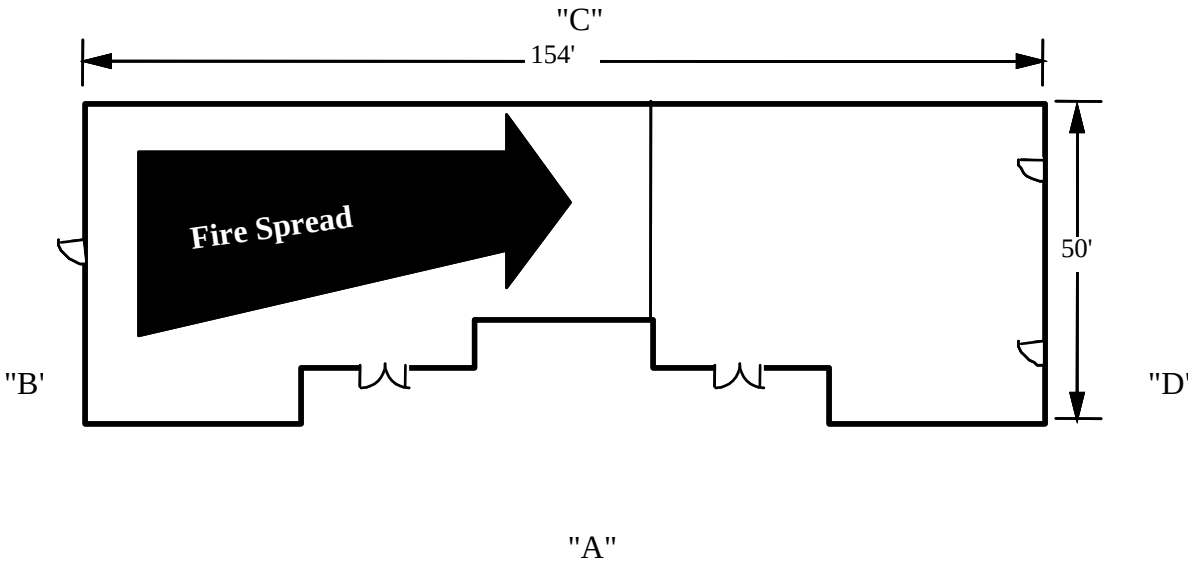
Case Study: Sunrise Gifts

This incident involved a fire in a one-story lightweight commercial occupancy. Collapse during firefighting operations resulted in the deaths of two firefighters; one member of the three-member crew operating inside the building escaped.

The Building:

This structure was of ordinary construction, with concrete block walls and a wood-truss roof assembly. The dimensions of the building were 154' x 50' (7,700 sq. ft.). The block walls were 12' in height. The truss roof assembly provided a 14' high void area above the ceiling. The trusses were pre-engineered wood constructed of 2" x 6" chords with 2" x 4" webbing, attached by sheet metal surface fasteners. The trusses were covered by 5/8" plywood, roofing felt, and precast clay tiles.

The floor area was divided into two occupancies; a 3,000-square foot restaurant, and a 4,000-square-foot mercantile occupancy. The truss space was divided into approximately 3,700-square-foot sections. However, the separation of the truss area was compromised by poke throughs for building services.



Fire Behavior:

The fire was believed to have originated in the truss space on Side B. Based on analysis by investigators, it was estimated that ignition occurred at approximately 1530 hours, and developed into a free-burning fire within three to five minutes. Driven by a 22-mph wind from Side B, the fire extended toward Side D.

During the early stages of the fire the air supply provided by the attic vents was sufficient to sustain fire growth. As fire volume increased, air supply became insufficient to support fire development. Bystanders reported that the fire was showing and then pulling back into the louvers in the dormer prior to the arrival of firefighting personnel.

At the time of collapse the entire roof from Side D to the center of the building was involved in fire. At the time interior operations were initiated, backdraft conditions may have been present in the truss area.

Firefighting Operations:

Initial operation involved deployment of a 1-3/4" handline to the interior of the store. Little or no heat and smoke were encountered. The handline was relocated to the exterior and operated into the dormer over the store on Side A. The operation of the stream had no effect on the fire. The line again was extended into the mercantile occupancy and positioned approximately 15 feet inside the structure. The ceiling was pulled and the handline was operated intermittently into the truss area. When a heavy body of fire was observed in the space above them, the CO ordered the crew to retreat from the building. At this point the crew heard a "popping" noise and the ceiling assembly collapsed, the first floor area became enveloped by extending fire, and the roof assembly collapsed.

ACTIVITY 4.2

FIRE BEHAVIOR PREDICTIONS

Purpose:

The purpose of this activity is to identify critical factors of fire behavior and fire, heat, and smoke travel. The instructor will have you review a series of slides and assign your group a scenario. Your group will be asked to answer the activity questions regarding your prediction about fire behavior.

The lack of an opportunity to learn by direct experience can be compensated for in part by a critical examination of others. The examination of these case studies illustrates how this type of information can be used on an individual, company, or department basis as part of a company officer training and development program.

LARGE GROUP ACTIVITY

Walk-through Scenario

A fire has been reported in a structure approximately five minutes prior to your arrival. The structure is approximately 30' by 50' with an attached garage. The neighbors report upon your arrival that the occupants are on vacation and no one is in the structure.

Directions:

As a large group answer the following questions about the structure in the scenario:

1. Is firefighter safety a concern? Why?

2. What classification or construction type is the structure?

3. Has flashover occurred yet? If not, does flashover appear to be a concern?

4. Does backdraft appear to be a concern?

5. How will fire, heat, and smoke travel through this structure?

6. Do you expect the amount of heat produced to be low, moderate, or high? Why?

ACTIVITY 4.2 (cont'd)

FIRE BEHAVIOR PREDICTIONS

SMALL GROUP ACTIVITY

Scenario 1

The structure is a two-story four-family townhouse complex with a common attic. A fire was reported in the basement workshop area. The owner reports to you that he was using an acetylene torch and the hoseline on the unit burst. A fire erupted and he called the fire department. The building was constructed in 1986.

Scenario 2

The fire has occurred in a three-story, 18-family building of ordinary construction built in 1936, with six apartments on each floor. The fire was reported from apartment 3B, and the caller stated that several occupants were trapped.

Scenario 3

The structure is a modern one-story shopping center constructed in 1985. The center common area has automatic smoke vents; there are no sprinklers present. A fire has been reported in the large french fryer of a fast-food restaurant and the caller stated that the automatic extinguishing system failed to operate.

Scenario 4

A fire has been reported from apartment 2B of a three-story wood-frame garden apartment complex. The structure has a center hall and is constructed in a manner typical for this occupancy. A second call was received from an occupant of the third floor stating that smoke was coming from her kitchen cabinets.

Scenario 5

A fire has been reported in the milking parlor of a large dairy barn. The original barn was constructed in 1948 and an addition was made in 1980. A new milking parlor was added at the intersection of the two barns and ties the two together. There are no doors on the openings from the milking parlor into the two barns.

ACTIVITY 4.2 (cont'd)

FIRE BEHAVIOR PREDICTIONS

Scenario Assigned:_____

SMALL GROUP ACTIVITY

1. Is firefighter safety a concern? Why?

2. What classification or type construction is the structure?

3. Has flashover occurred yet? If not, does flashover appear to be a concern?

4. Does backdraft appear to be a concern?

5. How will fire, heat, and smoke travel through this structure?

6. Do you expect the amount of heat to be produced to be low, moderate, or high? Why?

ACTIVITY 4.3

PREDICTING FIRE TRAVEL

Purpose:

The purpose of this activity is to review construction features, fire and smoke development, and to predict fire travel patterns. The instructor will show you a slide of a building and ask you questions about the expected fire travel within the structure or complex.

Scenario 1: Townhouse complex

What would happen if a fire started in the outside utility room closest to the entrance at the end of the townhouse (Side "A")?

Do you see anything unusual at the end wall (Side "D") of the townhouse?

Scenario 2: Duplex (two-family unit)

While it appears that the firewall held the fire from the adjoining dwelling, what will happen if the fire gets into the attic?

Scenario 3: Three-story rowhouses

What will happen if a fire gets into the attic and there are no firewalls, or they have been pierced?

ACTIVITY 4.2

BUILDING CONSTRUCTION CASE STUDIES

Case Study: Training Exercise

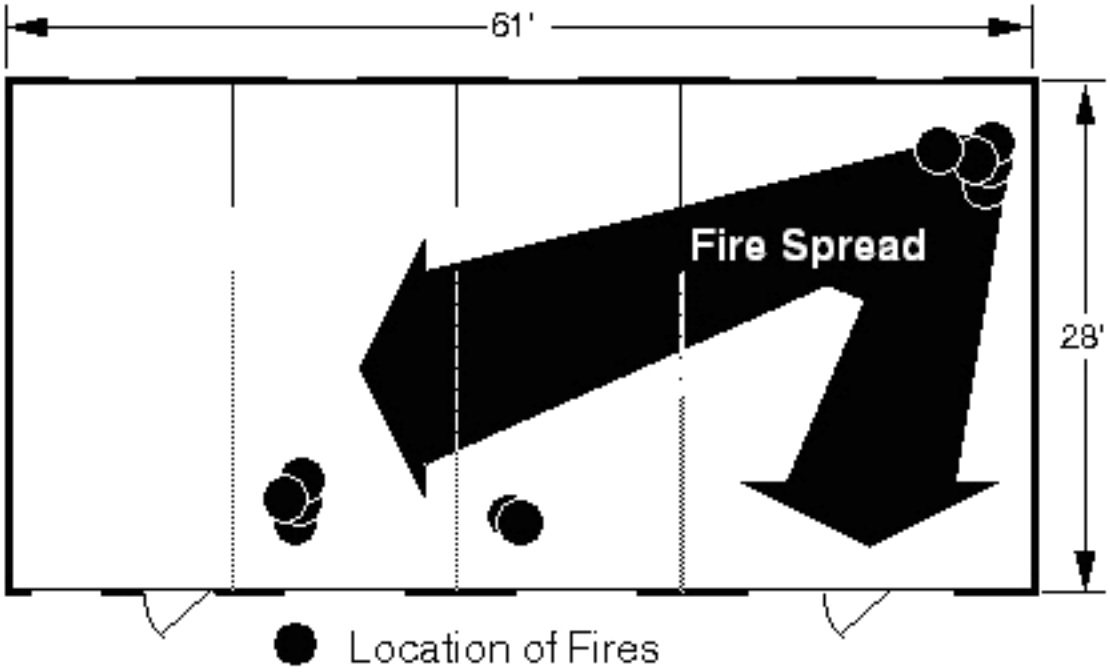
This incident involved live fire training exercise in a vacant storage building. The fires within the structure were intended to provide smoke for a search exercise. Automobile tires provided the principal fuel for smoke production. Due in part to the charactisertistics of the structure and resultant fire behavior, two firefighters were killed and two others were injured in this incident. Other factors also had a major impact on the outcome of this incident. In this activity, please focus on the construction and it's impact on fire behavior.

The Building

This structure was a wood frame storage shed 28' x 61'. The exterior walls were covered on both sides with 1" x 6" boards and were filled with sawdust insulation. The roof of the structure was of shed design and sloped from 11' to 5'

The entire ceiling of the structure was covered with low densitiy fiberboard. This material which consists of compressed wood fibers, as been a factor in a number of multiple fatality fires.

The floor area was divided with temporary wood barriers to provide the configuration illustrated below.



Fire Behavior

There were three seperate fires burning inside the structure as shown in the illustration. The fires had been burning for several hours as several Engine Companies participated in the training exercise. As the tires was consumed, additional fuel was provided to maintain smoke production. While the heat produced by each fire contributed to fire development, the point at which flashover began was at the corner of Sides C (charlie) and D (delta).

Early in the training exercise, personnel noted moderate heat and smoke conditions within the structure. As operations progressed, the heat level and volume of smoke increased. As the third Company started it's search evolution, rapidly building heat conditions were encountered. As personnel attempted to leave the structure, rollover was observed, with the fire extending from Side D (delta) toward Sides A (alpha) and B (bravo). Shortly after rolover conditions were observed, flashover occured, with extremely rapid fire spread throughought the structure.

Firefighting Operations

The Engine Company was performing search with a 1" booster line having a flow rate of 30 GPM. The flow rate from this hoseline was not sufficient to control the fire.

1. What construction type was involved?

2. Did the construction type impact on fire spread, and if so, how?

3. Did the stability of the structure under fire conditions impact on firefighting operations, and if so, how?

4. Based on this case study, what impact should the presence of this type of construction have on firefighting operations.

MODULE 5: PREINCIDENT PREPARATION

OBJECTIVES

The students will:

1. *Properly calculate required fire flow for structures using the National Fire Academy Fire Flow Formula.*

2. *Given the required fire flow for a structure, estimate the personnel required for offensive operations.*

3. *Given a scenario, properly complete a National Fire Academy Quick Access Prefire Plan.*

NOTE-TAKING GUIDE

FIRE FLOW REQUIREMENTS

Most structure fires are extinguished by absorbing the heat with water. Reducing the temperatures of the items that are burning below the ignition temperature will cause the fire to be extinguished.

The application of adequate quantities of water combined with appropriate ventilation will reduce temperatures and extinguish a fire.

In order to extinguish a fire, the quantity of water (gpm) must exceed the heat (Btu's) being produced.

FIRE FLOW FORMULA

Knowledge of fire flow is required for effective decisions on number of handlines and personnel to extinguish a fire.

NOTE-TAKING GUIDE

This formula is intended to calculate the **theoretical fire flow** for interior fire attack.

With high percentages of involvement, interior operations are not possible.

Origin of the formula.

Basic formula: $\frac{L \times W}{3}$ = gpm.

Multiple stories.

If additional floors or basement are occupied areas, the fire flow for additional floors must be included.

Fire-resistive buildings may be treated as exposures if not involved in fire.

NOTE-TAKING GUIDE

Exposures.

$$gpm = \frac{L \times W}{3} + \text{exposures.}$$

Exposure protection.

Percentage of involvement.

RESOURCE CAPABILITY AND DISTRIBUTION DATA

Important for CO to know the initial attack capability of engine company.

Capability/Distribution evaluation parameters.

NOTE-TAKING GUIDE

Hose Size	Flow Rates	Personnel/Line
1-1/2"	100 gpm	2
1-3/4"	150 gpm	2
2"	150 gpm	2
1-3/4"	240 gpm	3
2"	240 gpm	3
2-1/2"	300 gpm	4+

Strategy would include:

Distribution of personnel at a simple incident.

Incident Commander	1
Ventilation	2
Primary Search (2)/Fire Attack(4)/Pump Operation(1) (2 1-3/4" hoselines at 150 gpm each)	7
Total Personnel Required	10

NOTE-TAKING GUIDE

Distribution of personnel at a fire in a two-story building.

Incident Commander	1
1st Floor and 2nd Floor Supervisor(s)	2
Ventilation	4
Primary Search(3)/Fire Attack(8)/Pump Operation(1) (4 1-3/4" hoselines at 150 gpm each)	12
Total Personnel Required	19

Proactive use of the data.

Could the change of an attack line and nozzle improve fire flow capabilities of your fire department?

Hose Size	Flow Rates	Personnel/Line
1-1/2"	100 gpm	2
1-3/4"	150 gpm	2
2"	150 gpm	2
1-3/4"	240 gpm	3
2"	240 gpm	3
2-1/2"	300 gpm	4+

NOTE-TAKING GUIDE

QUICK ACCESS PREFIRE PLANNING

Who does prefire planning?

Purpose of the Quick Access Prefire Plan.

What buildings require a prefire plan?

Who uses Quick Access Prefire Planning?

SUMMARY

Fire flow requirements must be understood because of the effect on tactical decisions, resource needs, and safety concerns on the incident scene.

Knowing your resource capability in terms of gpm per person on scene assists in decisionmaking.

NOTE-TAKING GUIDE

Prefire planning provides "must know" information which increases one's ability to make correct decisions at an incident.

The course "Decisionmaking" will provide training in those skills that will assist you in making tactical decisions and carrying out tactical operations.

PREINCIDENT PREPARATION

Preincident preparation involves the process of preparing a preplan for a given building or hazard. This preplan should be comprehensive, but presented in a format which can be used by a CO while en route to an emergency. The Quick Access Prefire Plan (QAP) was developed to meet these needs.

Before the QAP can be prepared the CO must determine required fire flow and resource requirements for a given structure or hazard.

FIRE FLOW REQUIREMENTS

A sometimes difficult question that must be answered by the first officer to arrive at the scene of a fire incident is: How much water is needed for effective fire control? The answer to that question must be readily available and will have impact throughout the incident in terms of determining resource requirements and utilization, and the tactical operations that are employed.

Determining the amount of water required for fire control in a specific occupancy is best done during preplanning. During preplanning a calm and deliberate assessment can be made of the occupancy with proper emphasis being placed on particular features or conditions that should be considered when establishing the required fire flow. When preplanned fire flow information is available to the officer in charge upon arrival at the incident scene, decisions can be made more readily and with greater accuracy based on this information.

FIRE FLOW FORMULA

On occasion, fire incidents are encountered where preplanned fire flow information has not been developed or is not readily available. Under these circumstances fire officers are often able to make this determination using the NFA Fire Flow Formula. The NFA has developed a "quick-calculation" formula that can be used as a tactical tool to determine fire flow requirements at the scene of the incident. This formula can provide a starting point for deciding the amount of water required, apparatus needed to deliver the water, and the number of companies that should be used to apply it.

The NFA quick-calculation formula was derived through a study of fire flows which were successful in controlling a large number of working fires along with interviews with numerous experienced fire officers from

throughout the country regarding the fire flows they have found to be effective in various fire situations.

The information developed through these efforts indicate that the relationship between the area which is involved in fire and the approximate amount of water required to effectively extinguish the fire can be established by dividing the square footage of one floor of the structure by a factor of three. This quick-calculation formula is expressed as:

$$\frac{L \times W}{3} = \text{fire flow in gpm for one floor at 100\% involvement}$$

This formula is easily applied to the square footage of the entire structure by multiplying the fire flow for one floor by the total number of floors above the fire (up to four floors). After exposure charges are added (if any) it is then reduced accordingly for various percentages of fire involvement.

The example shown below illustrates how the formula can be used for a typical one-story, single-family wood-frame dwelling with approximate dimensions of 50 ft. by 30 ft.

$\frac{50' \times 30'}{3}$ = gpm or $\frac{1500}{3}$ = 500 gpm for one-story structure for 100% involvement

100% INVOLVED = 500 gpm

75% INVOLVED = 375 gpm

50% INVOLVED = 250 gpm

25% INVOLVED = 125 gpm

The quick-calculation formula indicates that if this structure were fully involved, it would require approximately 500 gpm to effectively control the fire. If only half of the building were burning, 250 gpm should suffice, and 125 gpm should be sufficient if one-fourth of the building were involved.

In multi-storied buildings, if more than one floor in the building is involved or threatened with fire, the fire flow should be determined based on the area represented by the number of floors that are actually burning. For example, the fire flow for a two-story building of similar dimensions as that used in the previous example would be:

$\frac{50' \times 30'}{3} \times 2 \text{ (floors)} = \text{gpm}$ or $\frac{1500}{3} \times 2 = 1{,}000 \text{ gpm}$

Total fire flow for two floors at 100% involvement is 1,000 gpm

100% INVOLVED = 1,000 gpm

75% INVOLVED = 750 gpm

50% INVOLVED = 500 gpm

25% INVOLVED = 250 gpm

In "fire-resistive" buildings, if other floors are not yet involved but are threatened by the possible extension of the fire (up to four floors above the fire floor), they should be considered as an exposure and 25 percent of the required fire flow for the fire floor should be added for exposure protection. In all other building construction classifications the floors above the fire should be included as part of the fire problem (up to four floors).

If adjacent structures are being exposed to fire from the original fire building, a 25 percent exposure charge of the required fire flow of the building should be added for each side of the fire building with exposures. Should the exposure actually become involved with fire, the exposure(s) then should be treated as a separate fire.

Rules of Thumb for Exposures

- Property that is less than 30 feet away is **most likely** an exposure.
- Property that is between 30 and 100 feet away is **probably** an exposure.
- Property that is over 100 feet away is **most likely not** an exposure.

However, one must evaluate the exposures with respect to the actual situation. This could mean a property 20 feet away would not be an exposure if there were a hill or other earthen barrier between it and the fire situation. Or, a building 150 feet away could be an exposure during heavy wind conditions, or if the fire building were an explosives manufacturer.

The example shown below illustrates how the quick-calculation formula is applied to a one-story structure that is fully involved and exposing two adjacent structures:

$$\frac{50' \times 30'}{3} \times 1 \text{ (floor)} = 500 \text{ gpm}$$

Exposure: 500 gpm x (25% x 2) = 250 gpm

Total Fire Flow Required = 750 gpm

In using the quick-calculation method to determine required fire flows it is important to remember that the answers provided by this formula are approximations of the amount of water needed to control the fire. You are estimating the area of the building and the amount of fire involvement within the building. Since firefighting is an inexact science to begin with, the use of the quick-calculation formula cannot be expected to determine the exact number of gpm that will be required for full fire control.

While the formula will provide the CO with a starting point to determine how much water may be needed for an effective fire attack in normal situations, common sense and good judgment also are required to evaluate the effect of the water once it is being applied. Once the needed fire flow is developed and is being placed on the fire, the fire should darken down in a minute or two. However, other factors may not be evident to the company officer. These include positioning of interior walls and partitions, piling of stock, flammable and combustible liquids or oxidizers, and significant failure of the roof (or other vertical assembles) that lets steam escape. If an immediate knockdown takes place, the amount of water being applied should be reduced to minimize water damage to the structure or its contents.

RESOURCE CAPABILITY AND DISTRIBUTION DATA

Once the required fire flow has been determined, the capability of available resources will determine the strategy and tactics that will be required to control the incident. If the fire flow capability of available resources exceeds the required fire flow, an attack on the fire usually can be made. However, before this decision is implemented the CO should consider the following:

1. Is it safe for offensive operations, based on existing conditions?

2. Is the fire area accessible?

3. How many hoselines are needed at what gpm?

4. How many people are needed for fire attack?

5. What are the best vantage points for applying the water?

6. What support activities are required?

7. What safety concerns do I have?

If, on the other hand, the fire flow requirement exceeds the fire flow capability of available resources, a defensive mode of operation is usually required. Depending on the particular situation, larger hose streams, more apparatus, more equipment, and more personnel may have to be requested. It also is important to remember that situations are encountered where little can be done to save the involved building with the resources available. Then exposure protection, by necessity, becomes the primary objective.

QUICK ACCESS PREFIRE PLANNING

Preincident planning information can be defined as the need-to-know information that is gathered and recorded in a usable format and maintained so that it is available to fire companies when responding to the specific occupancy.

The value of good preincident planning information can be illustrated simply by recalling the last time the company responded to a working fire in an occupancy that had been preplanned, and contrasting that experience with a similar response that had not been preplanned.

The preincident plan permits the CO to make early "informed" decisions as he/she arrives at the incident or incidents. Information is critical to size-up and the setting of incident priorities. The lack of good planning information forces the CO to guess in order to fill critical information voids as he/she sets goals.

Preincident information benefits all members of the chain of command and contributes to effective incident management. The fire scene or incident can be considered a problem that requires a solution. Since the most difficult portion of the problem-solving process is the development of facts, it can be seen that the analysis and eventual answers to the IC's problems can be found in the facts developed in the prefire plan process.

Quality information, therefore, enhances analysis and permits prioritization of initial actions. Accurate analysis also allows the CO to predict outcomes as he/she begins to apply resources to the incident. A good preincident plan should yield a good estimate of the resources that will ultimately be required for incident management.

Finally, good preincident planning is essential to a safe fire scene. The plan provides knowledge of layout, structural conditions, fire load and other factors which will determine how aggressive the CO intends to be as he/she considers risk versus benefit. Safety benefits should be considered an integral part of the prefire plan.

Preincident planning elements include, but are not limited to, the following:

Building Description
Occupancy
Hazard to Personnel
Water Supply
Estimated Fire Flow
Fire Behavior Predictions
Predicted Strategies
Problems Anticipated
Fixed Protection/Detection Systems

The reverse side should include a floor plan and a plot plan.

Building Description

The general description of the structure should include the construction classifications such as wood-frame balloon, ordinary, or noncombustible. The construction method and materials of the roof will be critical if your company is assigned to "ventilation" and the materials used to construct the floors could be vital to the safety of your personnel. This section of the QAP should paint a broad picture for you about the structure.

Occupancy

The occupancy of the structure may help prepare the responding officer for problems that may be anticipated. As an example, should the occupancy indicate that the structure houses a chemical warehouse, a hazardous materials incident could be anticipated.

Hazards to Personnel

The safety of your personnel is your first and foremost responsibility. It is necessary to evaluate special hazards about the structure that may not be readily apparent upon arrival. This should assist you in evaluating risk versus benefit for your anticipated operations.

Water Supply

The availability of water to sustain a fire suppression operation is critical. It is imperative that the location and available flow be recorded for easy access. If a static water source such as a pond is to be used in conjunction with a water shuttle, it is important to identify the source of the water, how many tankers/tenders will be needed, and whether or not a supply engine is to be dispatched to the water source. Since the available flow from hydrants may change during certain times of the day, an average available flow should be calculated.

Estimated Fire Flow

Using the NFA Fire Flow Formula the anticipated flow needed for the structure and exposures can be calculated. All the first-arriving officer needs to do is to estimate what percentage of the structure is involved. This also can be used to determine what hoselines should be used and how many personnel may be required. Should the fire flow requirements exceed your discharge capability, a defensive operation may be required until additional resources arrive.

Fire Behavior Prediction

Certain predictions about a fire may be possible on examination of a structure. As an example, if an open stairway is found, it can be expected that fire could extend quickly to the floor above. If the building has a high life hazard, such as a nursing home, and doors are normally blocked open, it can be expected that there will be rapid smoke travel throughout the structure.

Projected Strategies

If certain strategic goals can be identified during the on-site visit they should be noted. As an example, it may be appropriate to identify a "defensive" operational mode for a vacant factory or barn due to its

deterioration. It may be appropriate to identify an "offensive" operation to support primary search if the structure is less than 25 percent involved.

Problems Anticipated

This provides an opportunity to record special problems that may restrict or limit your operations. The presence of a concrete slab roof may present a difficult ventilation problem, or the parking of trucks/trailers around a warehouse may limit access.

Fixed Protection/Detection Systems

Standpipe

It is important to record the classification of the standpipe (I, II, or III) and the location of the connection.

Fire Pump

The presence of a fire pump will be critical for the development of the required fire flow for both standpipes and sprinklers. Since the operation of the pump may be critical to your ability to develop required fire flows and ensure that sprinklers operate properly, you should be familiar with the building's water supply system. In addition, the pump may activate on the standpipe system as you are operating, and a sudden surge of pressure may be experienced.

Sprinklers

It is important to note if a structure is protected by an automatic sprinkler system. The presence of sprinklers may be considered during the size-up and strategic decisionmaking process. Decisions such as supplying the system by one of the first-arriving engine companies may be critical. The notation of sprinkler placement on the preplan will remind the CO's driver/operator of the need to observe any difficulty encountered in supplying the system. If a pump is supplying a sprinkler system and is having a difficult time maintaining an operational pressure, it may be an indication that there are a large number of heads operating. Alternatively, the system may be broken/disconnected and the water is not reaching the fire. This information is vital for the pump operator to identify and inform the CO.

Fire Detection

The presence of a fire detection system is vital in identifying the location of the fire. The location of the annunciator panel should be indicated on the preplan along with the type of detection system (smoke, heat, automatic sprinkler, water flow, or other).

Use of the Plan

The continuing value of the preincident plan requires that it be recorded, shared, and maintained for use in the fire scene. The use of a common or standardized preplan form such as the National Fire Academy's Quick Access Prefire Plan is encouraged to provide consistent recording and ease of use on the incident.

Many departments use on-board computers to store preincident planning information. This method has been particularly useful in materials identification in hazardous materials incidents.

The microfiche system of storage provides for storage of large volumes of information in a small area and can provide hard copy (a piece of paper in your hand) capability.

The lock box is being used more frequently. The lock box is placed in a convenient, accessible location at the occupancy site and can contain the preincident plan, materials location, and other useful information such as current inventories. The fire department keeps the key.

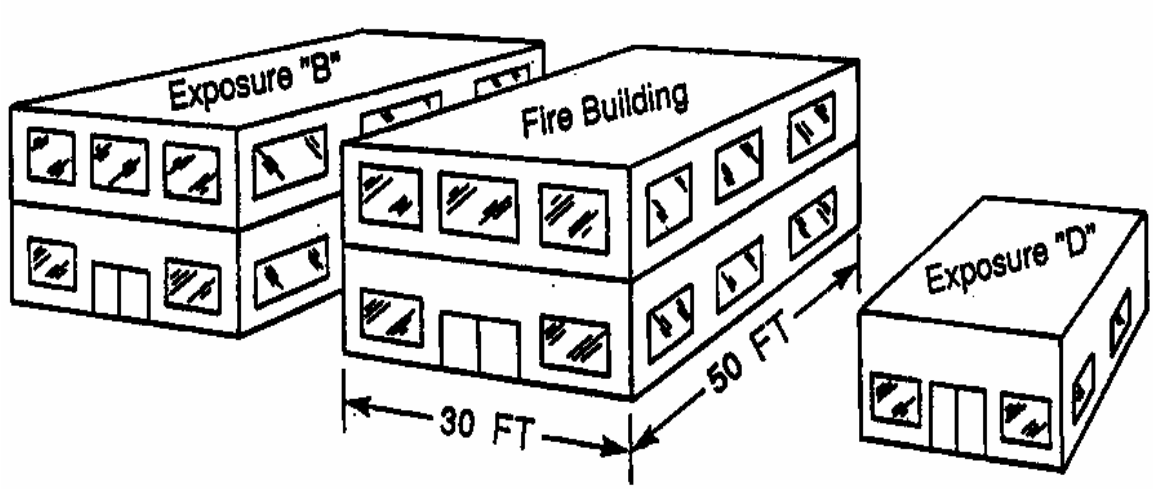
Regardless of the method of recording and maintaining the preincident plan, it must be updated as needed and shared with other fire companies.

Training must be conducted in the use of the plan. The training sessions must include all first-responding companies, and in some cases the occupancy management. The training should not be specific as to assignment of companies.

Preincident planning, like safety, is often overlooked. Quality preincident planning is essential if the CO intends to establish and maintain a proactive management environment.

ACTIVITY 5.1

FIRE FLOW WORKSHEET FOR PREFIRE PLANNING



WHAT IS THE FIRE FLOW AT:

25% 50% 75% 100%

ACTIVIYT 5.1

FIRE FLOW CALCULATION

Purpose:

The purpose of this activity is to practice calculating required fire flow for structures, using the NFA Fire Flow Formula.

Directions:

View the slide of a building being prefire planned and review the plot plan provided. This building is a two-story structure and has several exposed buildings facing two sides.

The preplanning officer wants to know the required fire flow needed to control the fire and protect interior and exterior exposures when there is an involvement of 25, 50, 75, and 100 percent for the fire building.

1. $\frac{\text{Length x Width}}{3} = \frac{\quad}{3} =$ _____ gpm per floor

2. gpm per floor _____ x 2 floors = _____ gpm

3. Exposure "B" (25% of total base flow) = ___ gpm

4. Exposure "D" (25% of total base flow) = __ gpm

5. 100% involvement plus 2 Exposures = ____ gpm

PERCENT	25%	50%	75%	100%
gpm				

Summary:

Calculation of required fire flow to successfully extinguish a fire is important in order to determine how much water is required to overcome the Btu's being produced by the fire.

ACTIVITY 5.2

PERSONNEL CAPABILITY AND DISTRIBUTION DATA

Purpose:

The purpose of the activity is to determine fire flow requirements for offensive operations and to make a determination of how many personnel will be required.

Directions:

You are operating at a fire in a one-story building that is 50 feet by 90 feet with a 25 percent involvement and no exposures.

What fire flow is required?

$$\frac{50 \times 90}{3} \times .25 = \_\_\_\_\_ \text{ gpm}$$

How many personnel will be required on scene if your department can do 30 gpm per person on the incident?

$$\frac{\text{gpm}}{30 \text{ gpm/Person}} = \_\_\_\_\_ \text{ Personnel Required}$$

If you are responding with a first alarm complement of 8 personnel, what conclusions can you make?

Summary:

In all cases, principles of safe operation must not be violated. All of the necessary functions must be performed.

ACTIVITY 5.3

QUICK ACCESS PREPLANNING

Purpose:

The purpose of this activity is to provide an overview of the NFA's Quick Access Prefire Plan.

Directions:

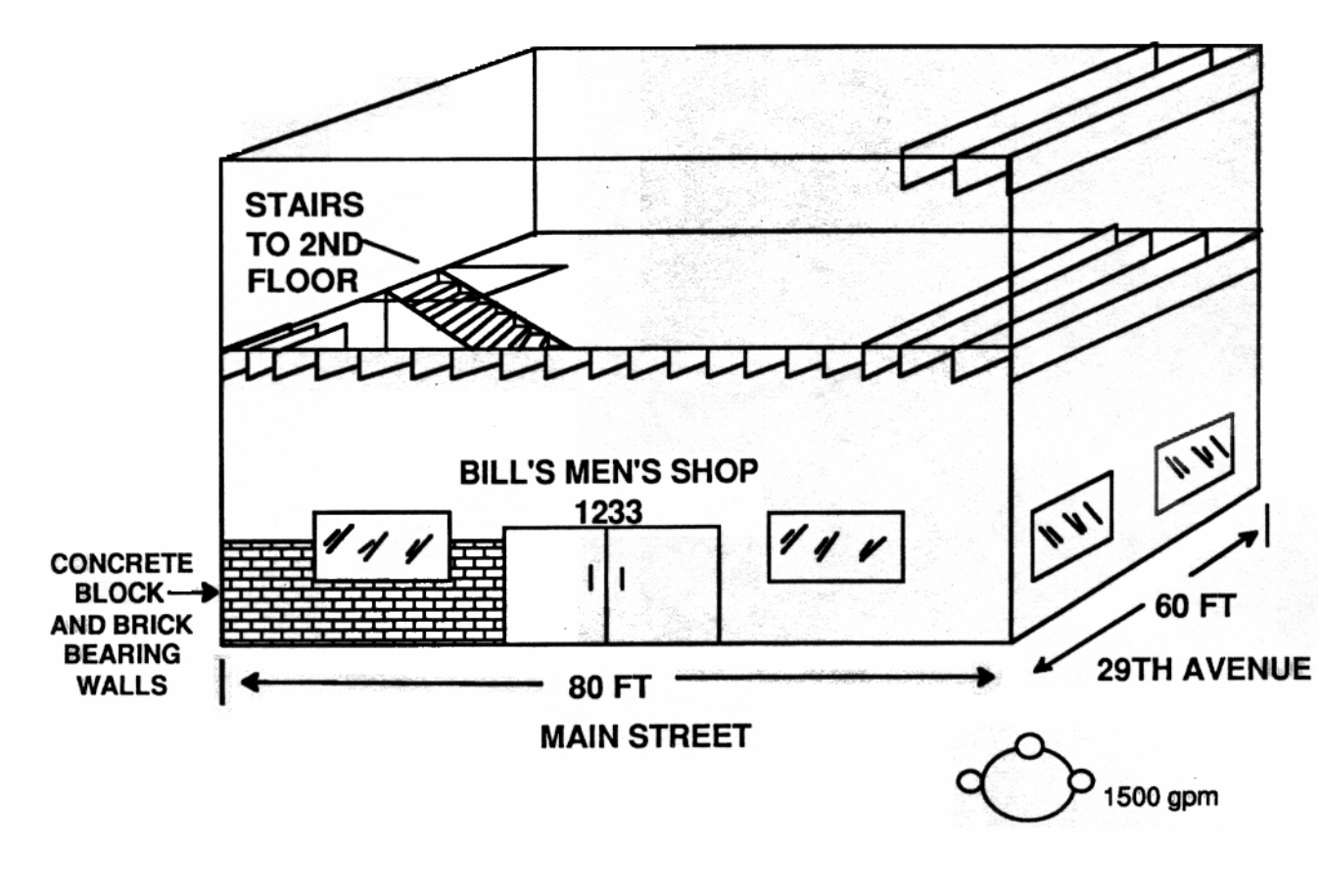
1. Review the floor plan for "Bill's Men's Clothing" which is a two-story, ordinary constructed building with a basement.

2. Following the instructor's directions complete the QAP for 1233 Main Street.

Summary:

The items included on this form are felt to be the ones on which good decisions are based. They will cover most areas of size-up when completed properly.

ACTIVITY 5.3 (cont'd)
PLOT PLAN/FLOOR PLAN



ACTIVITY 5.3

QUICK ACCESS PREFIRE PLAN

Building Address: *1233 Main Street*

Building Description: *2-story "ordinary" construction with basement*

Roof Construction: *Built up (tar & paper) over 2" boards*

Floor Construction: *1" boards over 2" x 10" joist*

Occupancy Type:	Initial Resources Required:
Mercantile "men's clothing"	*1 Rescue, 2 Engines, 1 Ladder*

Hazards to Personnel:
Large amount of rental clothing stored in basement

Location of Water Supply:	Available Flow:
Main Street & 29th Avenue	*1,500 gpm*

	Estimated Fire Flow			
Level of Involvement	*25%*	*50%*	*75%*	*100%*
Estimated Fire Flow	*800*	*1,600*	*2,400*	*3,200*

Fire Behavior Prediction:

Predicted Strategies:

Problems Anticipated:

☐ Standpipe:	☐ Sprinklers:	☐ Fire Detection:

ACTIVITY 5.4

BUILDING CONSTRUCTION AND FIRE BEHAVIOR PREDICTIONS

Purpose:

This activity provides the opportunity to evaluate a fire incident and make basic predictions about the resources needed to control the incident and make fire behavior predictions about the structure.

Directions:

Large Group Activity:

1. The instructor will show you a series of slides for 2 Knob Hill Road.
2. Complete the QAP for 2 Knob Hill Road along with the instructor.
3. Answer questions 1-10 along with the instructor.

Small Group Activity:

1. The instructor will assign each small group a scenario.
2. Read the brief description of your assigned structure.
3. The instructor will show you a series of slides for your assigned structure.
4. Select a spokesperson to represent your group.
5. Using the information that has been provided for your scenario complete the QAP and answer the questions about your structure.
6. Prepare to report group findings about scenario.

Summary:

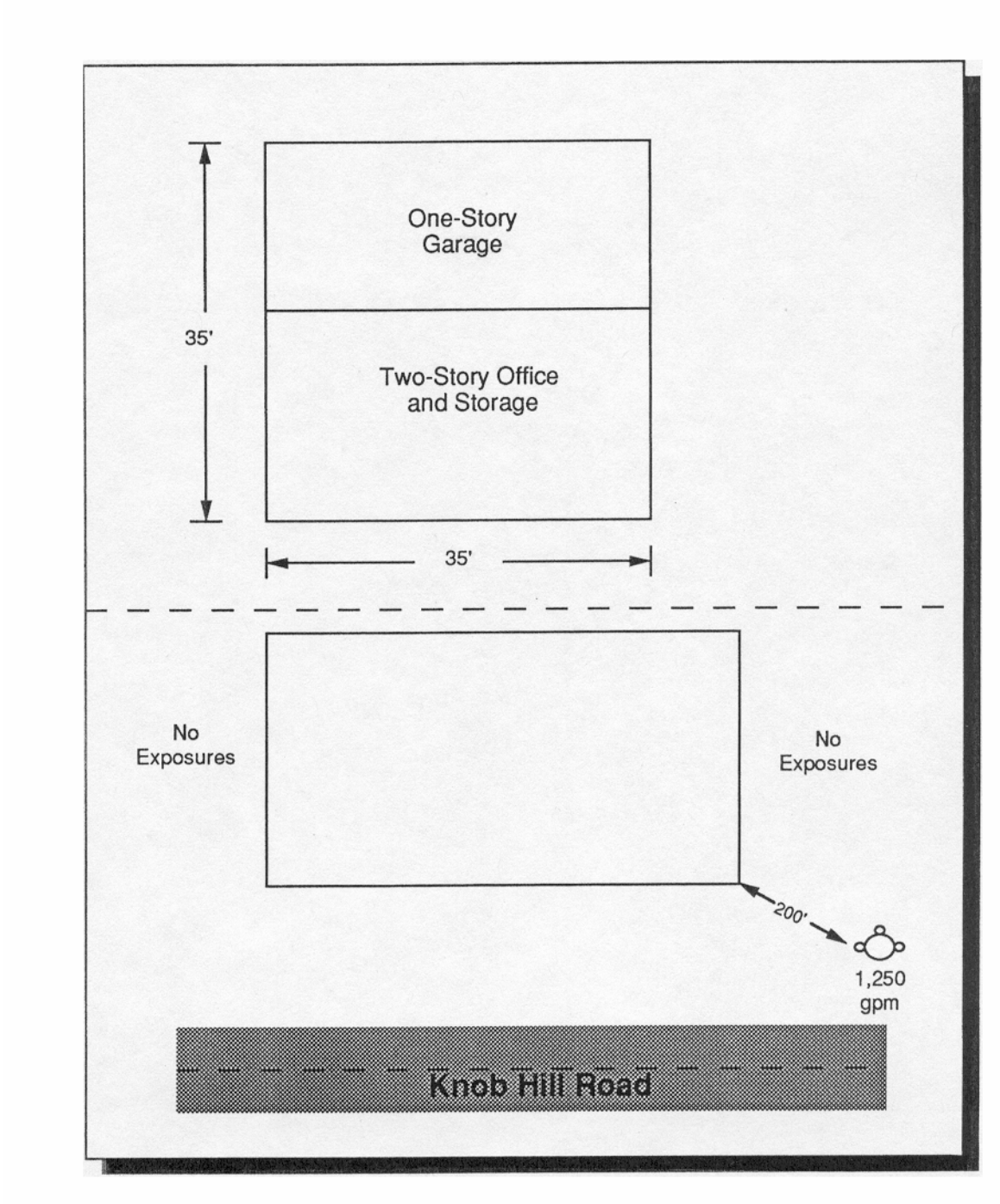
"Preparation" is the key to successful decisionmaking and tactical operations. Your ability to identify the key issues of a fire incident and identify the resources needed will be critical to a successful operation.

Walk-through Scenario: Truck Sales Office/Garage

Occupancy:

The structure has been converted from a dwelling to a truck repair sales and repair facility. It is 35' by 35' and was built as a single-family dwelling in 1938. The structure was modified in 1986 to accommodate the truck repair operation.

Activity 5.4
Walk-Through Scenario
Plot Plan/Floor Plan



Activity 5.4 (cont'd)
Walk-Through Scenario
Quick Access Prefire Plan

Building Address: *2 Knob Hill Road*

Building Description:

Roof Construction:

Floor Construction: *Boards over 2" x 6" joist*

Occupancy Type:	Initial Resources Required:

Hazards to Personnel:

Location of Water Supply:	Available Flow:
200' West	*1,250 gpm*

	Estimated Fire Flow			
Level of Involvement	*25%*	*50%*	*75%*	*100%*
Estimated Fire Flow				

Fire Behavior Prediction:

Predicted Strategies:

Problems Anticipated:

❑ Standpipe:	❑ Sprinklers:	❑ Fire Detection:

ACTIVITY 5.4 (cont'd)

BUILDING CONSTRUCTION AND FIRE BEHAVIOR PREDICTIONS

WALK-THROUGH SCENARIO

Questions:

1. What is the fire building construction type (classification)? _____

2. Where does the fire appear to be located? _____

3. What is the occupancy? _____

4. Was the structure constructed for the current occupancy? _____

5. Do there appear to be any significant construction deficiencies? _____

6. What factors of this building could be considered strengths? _____

7. What factors of this building could be concerns? _____

8. What avenues of fire, smoke, or heat travel would you expect? _____

9. Are there any special safety concerns you would have for your firefighters? _____

10. What is the fire flow requirements for: 100%, 75%, 50%, 25%?

ACTIVITY 5.4 (cont'd)

BUILDING CONSTRUCTION AND FIRE BEHAVIOR PREDICTIONS

Small Group

The instructor will show the class several series of slides for various classifications of structures. After reviewing the slides your instructor will assign your group one of the scenarios. As a group, answer the questions for your scenario. Each group will need a spokesperson to report the group's findings about its scenario.

Scenario 1

The structure is a storage barn, approximately 30' by 30'. It was constructed in 1934 with materials and techniques appropriate for that time. The barn currently is used for storage of fertilizer, seed, and pesticides.

Scenario 2

The structure is a single-family dwelling approximately 60' by 40', of irregular shape. The center portion was constructed in 1922; additions to both sides of the original structure were built in 1934.

Scenario 3

The structure is a single-family dwelling, constructed in 1951. The dwelling is 35' by 35' and the attic is used for the storage of old furniture. Prior to its sale in 1986, the structure was remodeled and a second bathroom was added on the second floor.

Scenario 4

The structure is a tavern which also serves light lunches and dinners. The building is 40' by 120' and was built in 1955. Since its original construction the building has been remodeled twice. The kitchen equipment is fueled by natural gas and consists of a french fryer, grill, and two stoves.

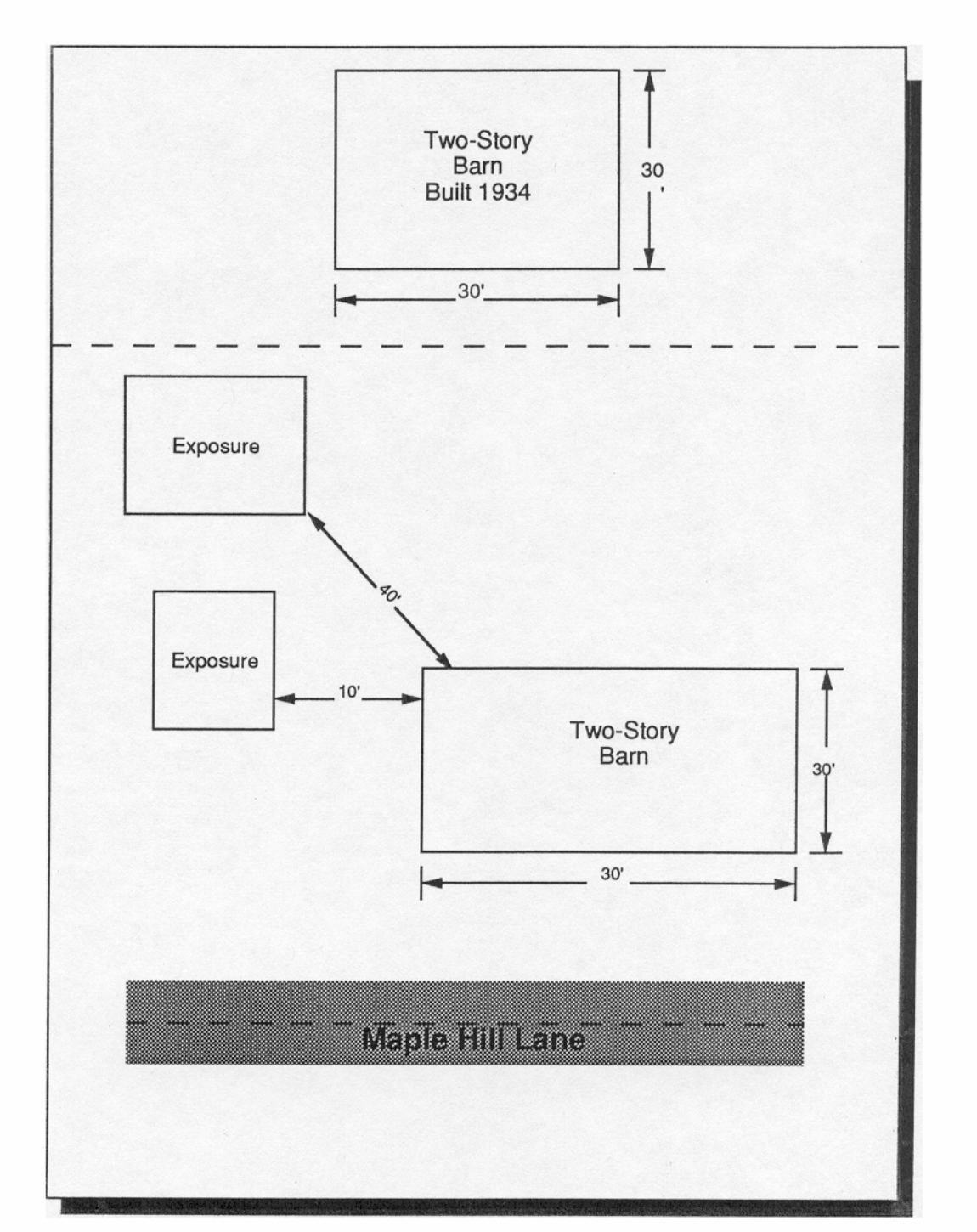
Scenario 5

The grocery store was constructed in 1976 and is 250' by 350' with an attached loading dock. The building has the typical fixtures and equipment expected for a full-service grocery store.

Scenario 6

The structure is a 12-story high-rise apartment building of a center-core design with the elevators (3) and stairways (2) located in the center of the building. Each floor, from the second to the top, has 10 apartments. The first floor is occupied by offices, an exercise room, and a community room. The structure is 60' x 80' and the fire is located on the fifth floor.

Activity 5.4 (cont'd)
Scenario 1
Plot Plan/Floor Plan



Activity 5.4 (cont'd)
Scenario 1
Quick Access Prefire Plan

Building Address: *21 Maple Hill Lane*

Building Description:

Roof Construction:

Floor Construction: *Dirt Floor*

Occupancy Type:	Initial Resources Required:

Hazards to Personnel:

Location of Water Supply:	Available Flow:
Pond 350' West	*500,000 gallons*

	Estimated Fire Flow			
Level of Involvement	*25%*	*50%*	*75%*	*100%*
Estimated Fire Flow				

Fire Behavior Prediction:

Predicted Strategies:

Problems Anticipated:

☐ Standpipe:	☐ Sprinklers:	☐ Fire Detection:

ACTIVITY 5.4 (cont'd)

BUILDING CONSTRUCTION AND FIRE BEHAVIOR PREDICTIONS

SCENARIO 1

Questions:

1. What is the fire building construction type (classification)? _____

2. Where does the fire appear to be located? _____

3. What is the occupancy? _____

4. Was the structure constructed for the current occupancy? _____

5. Do there appear to be any significant construction deficiencies? _____

6. What factors of this building could be considered strengths? _____

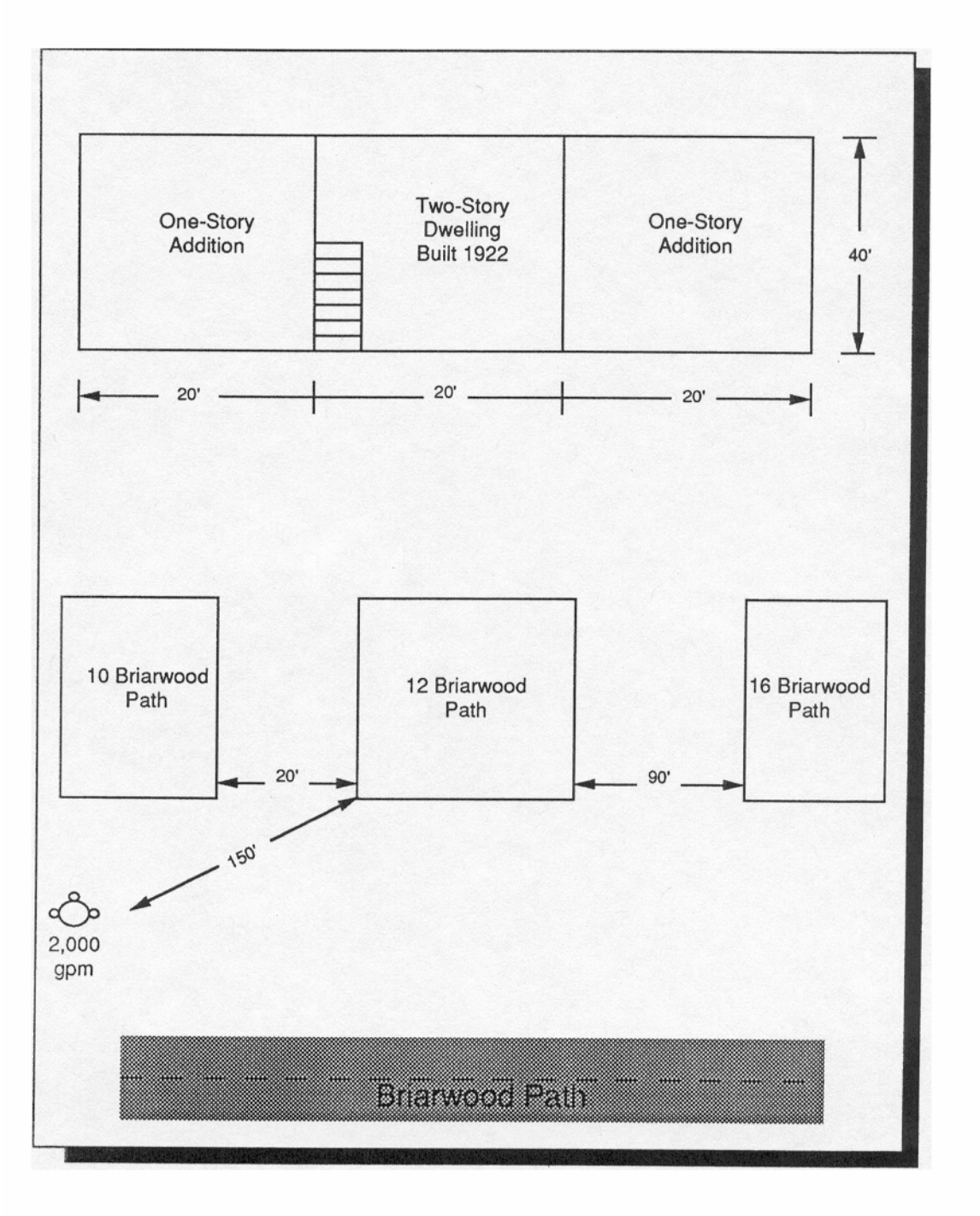
7. What factors of this building could be concerns? _____

8. What avenues of fire, smoke, or heat travel would you expect? _____

9. Are there any special safety concerns you would have for your firefighters? _____

10. What is the fire flow requirements for: 100%, 75%, 50%, 25%?

Activity 5.4 (cont'd)
Scenario 2
Plot Plan/Floor Plan



Activity 5.4 (cont'd)
Scenario 2
Quick Access Prefire Plan

Building Address: *12 Briarwood Path*

Building Description:

Roof Construction:

Floor Construction:

Occupancy Type:	Initial Resources Required:

Hazards to Personnel:

Location of Water Supply:	Available Flow:
150' East	*2,000 gpm*

	Estimated Fire Flow			
Level of Involvement	*25%*	*50%*	*75%*	*100%*
Estimated Fire Flow				

Fire Behavior Prediction:

Predicted Strategies:

Problems Anticipated:

☐ Standpipe:	☐ Sprinklers:	☐ Fire Detection:

ACTIVITY 5.4 (cont'd)

BUILDING CONSTRUCTION AND FIRE BEHAVIOR PREDICTIONS

SCENARIO 2

Questions:

1. What is the fire building construction type (classification)? _____

2. Where does the fire appear to be located? _____

3. What is the occupancy? _____

4. Was the structure constructed for the current occupancy? _____

5. Do there appear to be any significant construction deficiencies? _____

6. What factors of this building could be considered strengths? _____

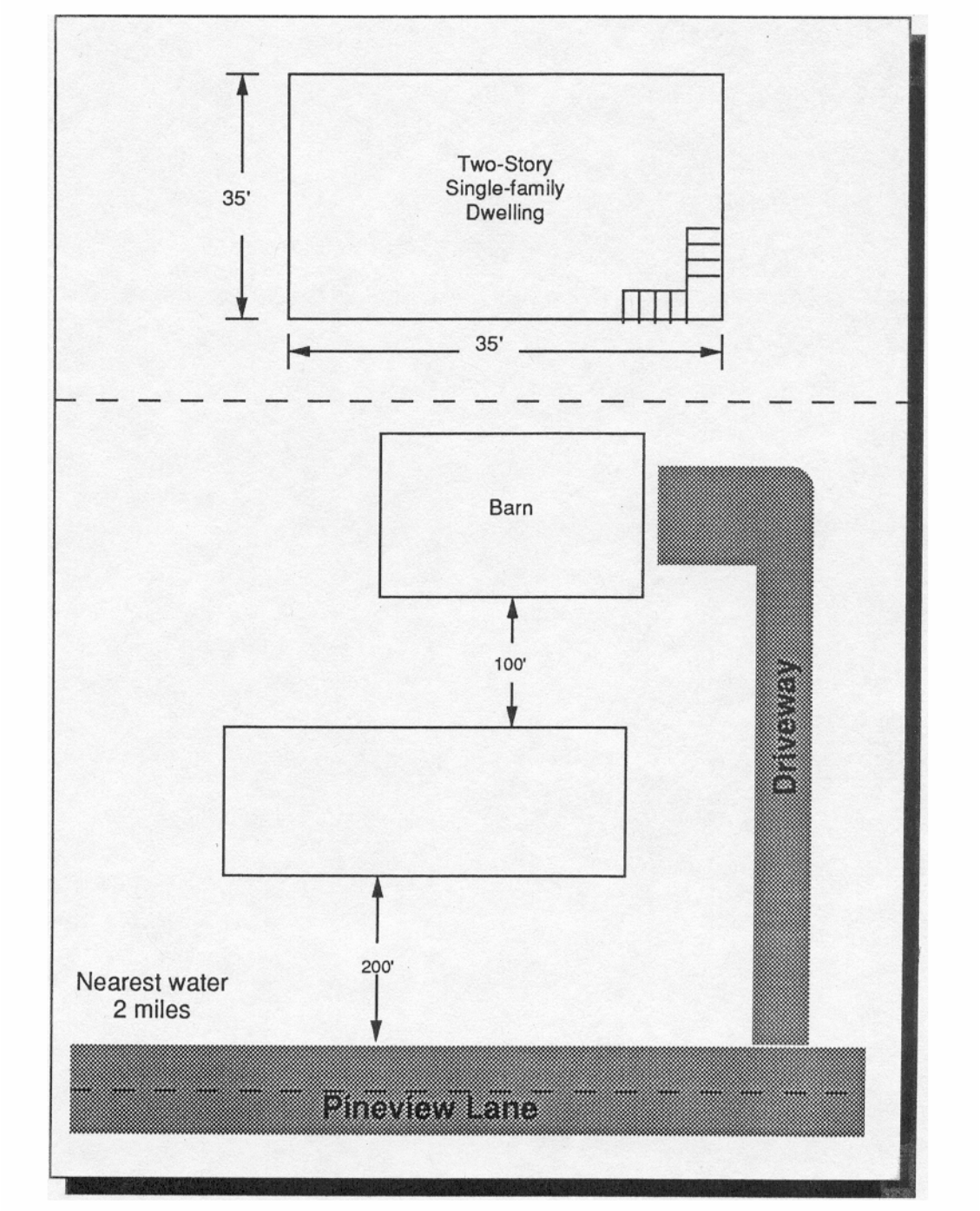
7. What factors of this building could be concerns? _____

8. What avenues of fire, smoke, or heat travel would you expect? _____

9. Are there any special safety concerns you would have for your firefighters? _____

10. What is the fire flow requirements for: 100%, 75%, 50%, 25%?

Activity 5.4 (cont'd)
Scenario 3
Plot Plan/Floor Plan



Activity 5.4 (cont'd)
Scenario 3
Quick Access Prefire Plan

Building Address: *RD 2 Box 143 Pineview Lane*

Building Description:

Roof Construction:

Floor Construction:

Occupancy Type:	Initial Resources Required:

Hazards to Personnel:

Location of Water Supply:	Available Flow:
2 Miles to West	*Pond; frozen during winter*

	Estimated Fire Flow			
Level of Involvement	*25%*	*50%*	*75%*	*100%*
Estimated Fire Flow				

Fire Behavior Prediction:

Predicted Strategies:

Problems Anticipated:

❑ Standpipe:	❑ Sprinklers:	❑ Fire Detection:

ACTIVITY 5.4 (cont'd)

BUILDING CONSTRUCTION AND FIRE BEHAVIOR PREDICTIONS

SCENARIO 3

Questions:

1. What is the fire building construction type (classification)?_____

2. Where does the fire appear to be located?_____

3. What is the occupancy?_____

4. Was the structure constructed for the current occupancy?_____

5. Do there appear to be any significant construction deficiencies?_____

6. What factors of this building could be considered strengths?_____

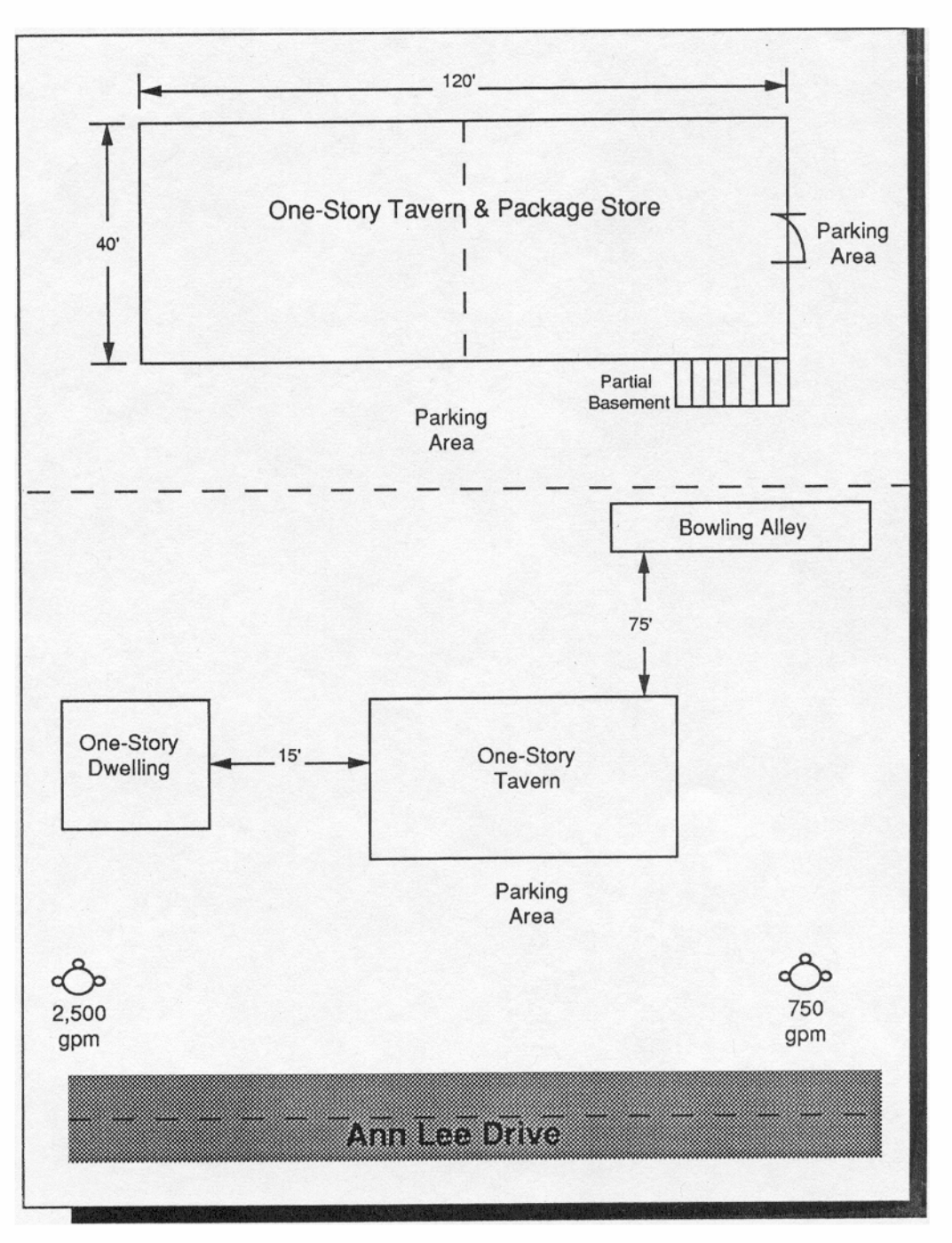
7. What factors of this building could be concerns?_____

8. What avenues of fire, smoke, or heat travel would you expect?_____

9. Are there any special safety concerns you would have for your firefighters?_____

10. What is the fire flow requirements for: 100%, 75%, 50%, 25%?

Activity 5.4 (cont'd)
Scenario 4
Plot Plan/Floor Plan



Activity 5.4 (cont'd)
Scenario 4
Quick Access Prefire Plan

Building Address: *1247 Ann Lee Drive*

Building Description:

Roof Construction:

Floor Construction:

Occupancy Type:	Initial Resources Required:

Hazards to Personnel:

Location of Water Supply:	Available Flow:
One at each corner of Ann Lee Drive	*750 gpm and 2,500 gpm*

	Estimated Fire Flow			
Level of Involvement	*25%*	*50%*	*75%*	*100%*
Estimated Fire Flow				

Fire Behavior Prediction:

Predicted Strategies:

Problems Anticipated:

☐ Standpipe:	☐ Sprinklers:	☐ Fire Detection:

ACTIVITY 5.4 (cont'd)

BUILDING CONSTRUCTION AND FIRE BEHAVIOR PREDICTIONS

SCENARIO 4

Questions:

1. What is the fire building construction type (classification)?_____

2. Where does the fire appear to be located _____

3. What is the occupancy?_____

4. Was the structure constructed for the current occupancy?_____

5. Do there appear to be any significant construction deficiencies?_____

6. What factors of this building could be considered strengths?_____

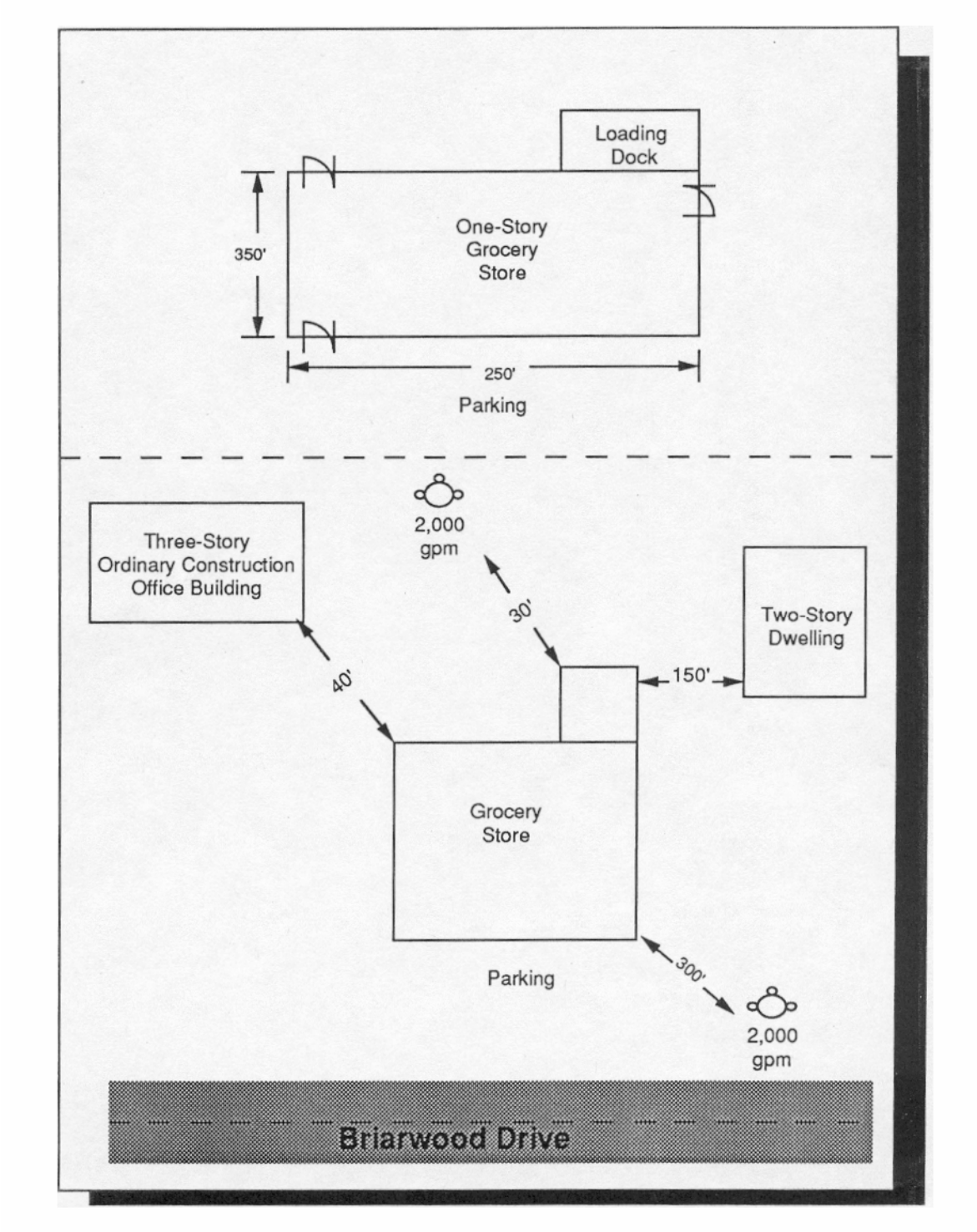
7. What factors of this building could be concerns?_____

8. What avenues of fire, smoke, or heat travel would you expect?_____

9. Are there any special safety concerns you would have for your firefighters?_____

10. What is the fire flow requirements for: 100%, 75%, 50%, 25%?

Activity 5.4 (cont'd)
Scenario 5
Plot Plan/Floor Plan



Activity 5.4 (cont'd)
Scenario 5
Quick Access Prefire Plan

Building Address: *2121 Briarwood Drive*

Building Description:

Roof Construction:

Floor Construction:

Occupancy Type:	Initial Resources Required:

Hazards to Personnel:

Location of Water Supply:	Available Flow:
One on Briarwood Drive, and one 30 ft. from store	*Two 2,000 gpm hydrants*

	Estimated Fire Flow			
Level of Involvement	*25%*	*50%*	*75%*	*100%*
Estimated Fire Flow				

Fire Behavior Prediction:

Predicted Strategies:

Problems Anticipated:

☐ Standpipe:	☐ Sprinklers:	☐ Fire Detection:

ACTIVITY 5.4 (cont'd)

BUILDING CONSTRUCTION AND FIRE BEHAVIOR PREDICTIONS

SCENARIO 5

Questions:

1. What is the fire building construction type (classification)?_____

2. Where does the fire appear to be located?_____

3. What is the occupancy?_____

4. Was the structure constructed for the current occupancy?_____

5. Do there appear to be any significant construction deficiencies?_____

6. What factors of this building could be considered strengths?_____

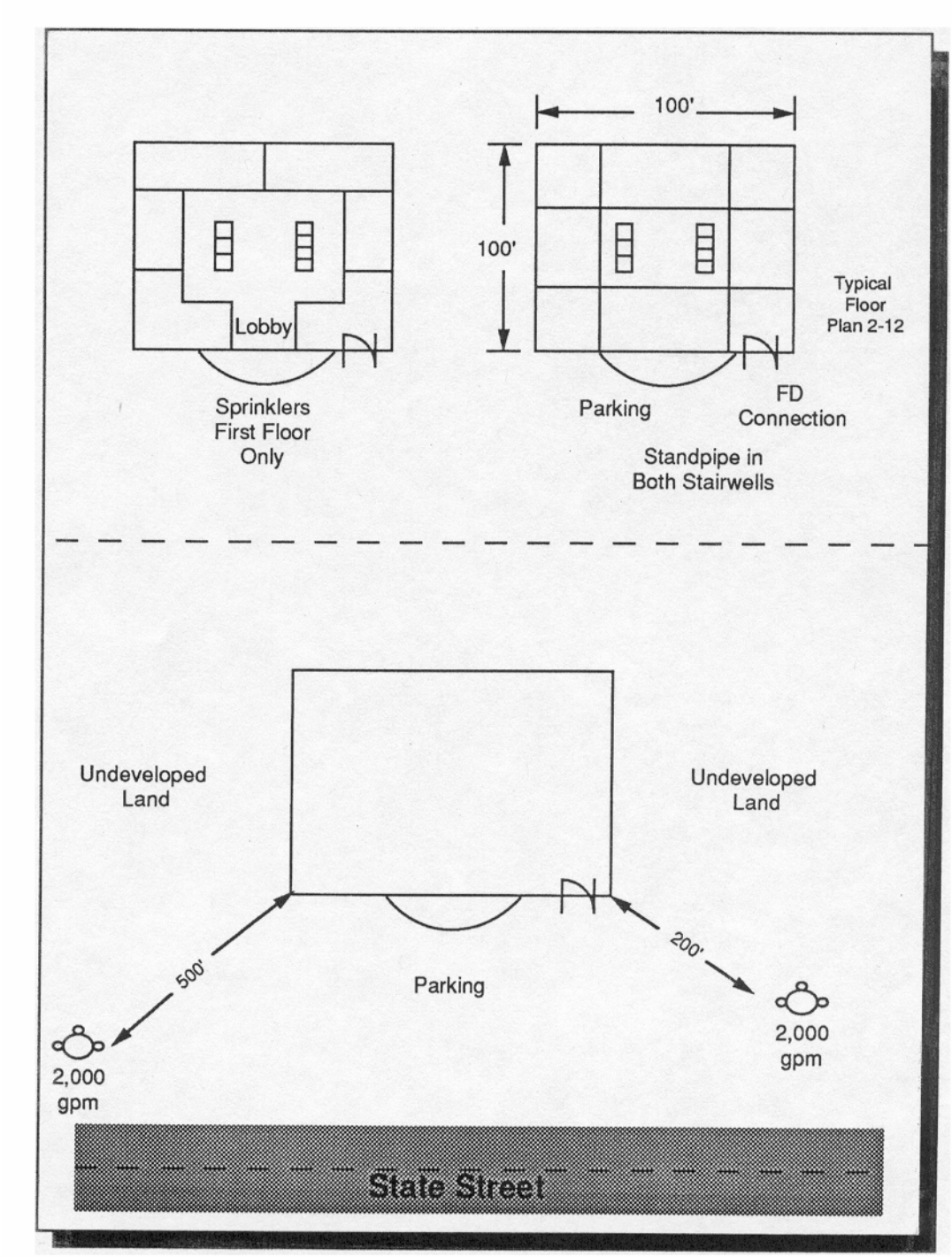
7. What factors of this building could be concerns?_____

8. What avenues of fire, smoke, or heat travel would you expect?_____

9. Are there any special safety concerns you would have for your firefighters?_____

10. What is the fire flow requirements for: 100%, 75%, 50%, 25%?

Activity 5.4 (cont'd)
Scenario 6
Plot Plan/Floor Plan



Activity 5.4 (cont'd)
Scenario 6
Quick Access Prefire Plan

Building Address: *41 State Street*

Building Description:

Roof Construction:

Floor Construction:

Occupancy Type:	Initial Resources Required:
Hazards to Personnel:	
Location of Water Supply: *One on each corner of State Street*	Available Flow: *Two 2,000 gpm hydrants*

	Estimated Fire Flow			
Level of Involvement	*25%*	*50%*	*75%*	*100%*
Estimated Fire Flow				

Fire Behavior Prediction:

Predicted Strategies:

Problems Anticipated:

☐ Standpipe:	☐ Sprinklers:	☐ Fire Detection:

Activity 5.4 (cont'd)

Building Construction and Fire Behavior Predictions

Scenario 6

Questions:

1. What is the fire building construction type (classification)?_____

2. Where does the fire appear to be located?_____

3. What is the occupancy?_____

4. Was the structure constructed for the current occupancy?_____

5. Do there appear to be any significant construction deficiencies?_____

6. What factors of this building could be considered strengths?_____

7. What factors of this building could be concerns?_____

8. What avenues of fire, smoke, or heat travel would you expect?_____

9. Are there any special safety concerns you would have for your firefighters?_____

10. What is the fire flow requirements for: 100%, 75%, 50%, 25%?